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Knowledge Domains and Skills that Facilitate Knowledge Sharing in Project Management

- A Case Study in the Chinese Construction Industry

By:

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Abstract

The aim of this thesis is to identify different sets of skills that facilitate the knowledge sharing practice of project managers within the context of a construction project. This aim stems from a gap identified in the knowledge sharing literature concerning the individual skills that contribute to knowledge sharing by project managers in the applied setting of construction projects.

In order to achieve the research aim, an exploratory qualitative study was conducted following a combination of Grounded Theory and case study as the research method. The study focuses specifically on a construction project in China. The construction industry in China has been experiencing an increasing development as a result of the national economy's sustained growth and continuing urbanisation trends, but it is still confronted with challenges in knowledge sharing practice especially concerning the role of project manager, who performs the high level control of projects. Grounded Theory is the main method and a case study provides the appropriate context for the research. Empirical data were collected through a total of twenty-one interviews at a five-star hotel construction project, located in Hebei Province, eastern China.

Following the constant comparison method, iterations in data analysis contributed to the development of an integrative framework. The framework indicates knowledge pertaining to five domains, including risk, planning, implementation, people, and business strategies and operations, needs to be shared by project managers. It also illustrates three sets of skills that contribute to the practice of sharing knowledge. Social cognitive skills assist project managers in interpreting differences in knowledge and achieving mutual understanding; interpersonal skills facilitate knowledge sharing through creating a positive project environment; strategic orientation skills contribute to reaching agreement among participating organisations and stakeholders. Furthermore, the framework reveals the specific relationships between the knowledge domains and skills, within the three phases of the construction project. In addition, findings suggest that the sharing of knowledge and the application of skills are of a dynamic and relational nature. The project is a collective and interactive process where

knowledge pertaining to different domains needs to be dynamically shared and skills need to be dynamically applied. The knowledge domains and skills do not operate independently but overlap and interact over the duration of the project. Moreover, they are open to different interpretations according to various positions of actors within the project.

This thesis contributes to an enhanced theoretical understanding of skills for knowledge sharing in the specific context of construction projects. It also delivers practical guidance for project managers on how to develop and apply the skills in these knowledge sharing practice.

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Chapter 1: Introduction

1.1 Research background

The competitiveness of a business has traditionally been ascribed to how well it allocates resources, capital and labour (Tzortzaki & Mihiotis, 2012). The modern economy has extended this concept to include knowledge as another key element that increases organisational competitiveness, particularly in improving efficiency and in assisting sustained success (Anand & Singh, 2011; Zareie & Navimipour, 2016). With an increase of studies in this field, knowledge sharing has become a dominant topic in managing knowledge (Schauer et al., 2015), and a central activity in the strategic management of organisations (Navimipour & Charband, 2016). Knowledge sharing is defined as a process where information is framed within a specific context by the knowledge of the source, and is being given out and received (Sharratt & Usoro, 2003); during this process, what is received is "*the information framed by the knowledge of the recipient"* (p. 188). Knowledge sharing is identified with the potential to deliver a variety of crucial benefits to organisations, including improving employee communication, optimising knowledge distribution, and enhancing the transformation from individual knowledge into organisational competitive advantages (Goh, 2002; Hendriks, 1999; Li et al., 2017).

Project is widely recognised as one of the most important modes in organisations (Brookes, Morton, Dainty, & Burns, 2006; Wei & Miraglia, 2017) and provides the route to product delivery (Almeida & Soares, 2014). For project-based industries where the surrounding business environment is competitive and complex, knowledge is considered as a crucial resource for organisational and project success (Egbu, 2004). Sharing knowledge within projects is a crucial learning approach that offers insights from different individuals, enabling the project to react to market changes in a flexible and timely manner(Lampel, Scarbrough, & Macmillan, 2008; Li et al., 2017). A considerable interaction perceived between the areas of project management and knowledge management is that knowledge management provides methods and techniques to access and share individual knowledge and to address different concerns within the project, whilst the practices of doing these enable the exchange and sharing

of knowledge (Michels, Grijó, Machado, & Selig, 2013). Knowledge sharing contributes to project success by enabling the mobility of sustainable knowledge which contributes to problem solving and long-term competitiveness.

Project managers, who hold a critical position and with a direct influence over 34-47% on project success (Hwang & Ng, 2013), play an important role in facilitating knowledge sharing within the project. The responsibilities of project managers mainly focus on applying different tools, resources and strategies to manage and control the process of a project, with the aim of achieving project objectives (Newton, 2012). From a knowledge sharing perspective, project managers apply their skills and techniques in transferring and sharing knowledge to improve the whole project performance via succession planning, leadership and teamwork (Liebowitz & Megbolugbe, 2003). In this sense, these techniques and skills are attached to the acquisition and utilisation of individual intangible knowledge in the project team; appropriate skills facilitating knowledge sharing can help to decrease the limitations of the temporal nature of a project and increase the competitive advantage, both for the project and parental organisations. To manage the project and share knowledge efficiently, project managers should possess the required skills and knowledge (Hwang & Ng, 2013).

Nevertheless, project managers often experience difficulties in sharing knowledge (Li et al., 2017; Wiewiora, Murphy, Trigunarsyah, & Brown, 2014). This is due to project contexts differing from those of traditional organisations. The challenge of understanding knowledge sharing practices in the context of projects, remains; this is largely a result of a typical characteristic of the temporary and complex nature of the project environment, namely the considerable flow of information and knowledge that is difficult to share and make sense of (Almeida & Soares, 2014; Li et al., 2017; Solli‐Sæther, Karlsen, & Oorschot, 2015).

In projects, the knowledge being shared and the skills applied to enable sharing are constituted by both the ongoing activities within the temporary time frame and diverse individuals from different disciplines. The inherent complexity, multiplicity and time limit of such settings complicate how knowledge sharing and skill are normally studied in organisations. Existing studies continue to report limited evidence of knowledge

sharing at inter- and intra- project levels (Boh, 2007; Kasvi, Vartiainen, & Hailikari, 2003; Wiewiora et al., 2014). Most of the current knowledge sharing theories are based on organisational context and are too generic to be directly applied or be entirely valid in project settings (Napier, Keil, & Tan, 2009); one key challenge that managers are confronted with is how knowledge sharing can be achieved effectively in the constantly changing project environment (Herbst, 2017).

More importantly, many researchers recognised that most knowledge-sharing barriers are people-oriented than technology or process-oriented (Heisig et al., 2016). However, most of the existing knowledge sharing theories are based on organisational or technical perspectives, without in-depth exploration on the important influence of people, especially personal skills (Li et al., 2017). There is therefore a need to investigate how people engage in their knowledge sharing practices through adopting personal or individual skills. Studies about project management examine the skills for project managers from a wide range of perspectives including project efficiency and performance (Fisher, 2011; Sunindijo, 2015), project safety (Sunindijo, Zou, & Dainty, 2017), international project context (Brière, Proulx, Flores, & Laporte, 2015) and information technologies (Bakker, Boonstra, & Wortmann, 2012). However, very few have been conducted from a knowledge sharing perspective to explore what critical knowledge and skills are required by project managers in their work (Hwang & Ng, 2013). Studies focusing on knowledge management in a project context have examined areas such as its benefits and challenges (Ghobadi & Mathiassen, 2016), factors for knowledge management success (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015), and knowledge management and sharing approaches (Yongjie, Lu, Guanghui, & Shijue, 2015). Recently, some studies also appear to focus on knowledge areas or types that are critical within the project context (e.g. Hwang & Ng, 2013; Hu, Xia, Ye, & Skitmore, 2015). Nonetheless, the skills contributing to knowledge sharing practice for the particular role of project manager are still rarely explored.

This raises a particular challenge to be addressed in the knowledge sharing studies within the context of projects: theories with a focus on individual skills contributing to knowledge sharing need to be generated, in order to support project managers' knowledge sharing practices and activities. Furthermore, projects vary significantly due

to contextual difference. It is difficult to apply existing knowledge sharing theories in organisational practice especially to the context of the construction industry (Xu, Zhao, & Wang, 2009). In fact, most of the knowledge sharing and knowledge management research have generic applicability while not being entirely valid for specific organisational contexts (Li et al., 2017; Napier et al., 2009). Therefore, there is a specific contribution to be made to knowledge sharing and knowledge management studies that pertain to project managers' skills in particular industries.

The construction industry is a largely project-based sector, in which each project has unique content and characteristics and is realised by different stakeholders who work towards a mutual target during various phases of the project lifecycle (Alhaji, Amiruddin, & Abdullah, 2013). Kamara, Augenbroe, Anumba, and Carrillo (2002) used the metaphor of a multidiscipline temporary institute to describe its nature. They consider that each construction project is a multi-disciplinary temporary institute in the sense that once the construction project is completed, the project experts and stakeholders involved split up, and may or may not work together again. Such a temporary nature makes construction organisations and the industry relatively fragmented and complex. At the same time, it is a knowledge-intensive industry that relies on stakeholders and organisations from distinguished backgrounds to share a large amount of knowledge throughout the project lifecycle (Dave & Koskela, 2009; Li et al., 2017). The knowledge and experience gained during previous construction projects need to be shared and transferred in order to maximize achievements in the current and subsequent projects (Ho, Tserng, & Jan, 2013). Additionally, project managers from different participating companies within the project need to share knowledge effectively to satisfy stakeholders' requirements (Hu et al., 2015).

The combination of these two major characteristics makes knowledge sharing difficult but pivotal in the management of construction projects. Especially with a rapid growth in the popularity and application of knowledge management and knowledge sharing, the construction industry shows a strong intention to implement these practices in order to tackle problems and trends such as project delays and the waste of resources (Robinson, Carrillo, Anumba, & Al-Ghassani, 2001). A construction project contains various types of technical and expert knowledge such as architectural design, electrical

infrastructure and structural design, each of which is of significant importance for the success of the project. The sharing of knowledge across different expert groups and ensuring that accurate knowledge flows to the right person at the right time is significantly crucial in gaining control over the whole project and to work towards project completion.

In China, the size of the construction industry has expanded rapidly in recent years (Hu et al., 2015). The construction industry and associated organisations have been under noticeable pressure to improve efficiency throughout the whole construction process, as well as to increase competitive capabilities based on quality rather than on price (Wei, Liu, & Wang, 2005). There have been major developments in urbanisation policy; since the 18th National Congress of the Communist Party of China in 2012, when the new group of leaders was formed, President Xi and the government have emphasised the importance of urbanisation. In 2014, the "National Plan on New Urbanisation (2014-2020)" was officially published, becoming the first urbanisation scheme approved by the central authorities (SCIO, 2014). The construction industry is a key component of urbanisation, and has attracted attention and a growing flow of investments from both the Chinese government and citizens.

Knowledge sharing in the construction industry is a relatively new concept in China; China is still is not recognised in the list of global organisations that effectively manage their knowledge (Huang, Davison, & Gu, 2011). It is also the case that project management and knowledge sharing are not simply focused on a linear understanding of project execution, but also involve social factors. However, experiences and lessons gathered from knowledge sharing practice in western countries are difficult to apply directly to Chinese industries given the different background, the specificities of Chinese culture, and the different ways of sharing knowledge (Huang et al., 2011). There is evidence of information technology being widely applied in China since the mid-1980s, although very few successful IT-based knowledge management or knowledge sharing applications are being reported, which suggests that *"in the digital era, there is still no perfect substitute for the motivational effects of human bonding and social connectedness"* (Lu, Leung, & Koch, 2006, p. 33). Similarly, specific Chinese social dimensions should be taken into consideration when investing in knowledge

sharing within the construction industry. Therefore, research into knowledge sharing needs to incorporate cultural and social factors that do relate to individual performance and social connections (Huang et al., 2011). To date, a lack of research still exists on such topics in the Chinese context.

The importance therefore, moves towards the need to better understand the individual skills that should be applied by, and support project managers, in their knowledge sharing practice; the Chinese construction industry is a particular context that requires this. Considering the importance and limited number of knowledge sharing theories for the role of project manager, as well as the demand for research with a focus on skills facilitating knowledge sharing within construction projects, this thesis attempts to fill the gap by identifying critical skills contributing to knowledge sharing in the context of project management in China, and investigating the application of these. Moreover, this research is also driven by the general aim of practically assisting project managers to identify, develop and apply relevant skills in their day-to-day knowledge sharing activities.

1.2 Research question and objectives

Considering the research context presented above, the following research question is formulated:

What skills contribute to effective knowledge sharing for project managers in construction projects?

The research aims to investigate the skills contributing to knowledge sharing from the perspective of project managers, in the context of the construction industry in China. It offers insights into the knowledge domains and skills involved in knowledge sharing practice by focusing on the role of project manager, and attempts to improve efficiency and quality of construction projects via eliciting project managers' critical skills in knowledge sharing. This firstly contributes to a better understanding of "what is going on" in terms of knowledge sharing practices in the Chinese construction projects, particularly in terms of how project managers engage in and affect knowledge sharing in their project teams. As a qualitative study, it reports a thorough and comprehensive exploration of this phenomenon within the specific cultural, political and project-

related conditions of the Chinese construction sector. More importantly, the outcome of this research is an integrative framework not only describing knowledge domains and skills required for project managers to effectively share knowledge in construction projects, but also offering a specific analysis of the interactions between the knowledge domains and the skills identified in practice.

In order to answer the research question and achieve the research aims, four objectives are established. To identify the skills, it is important to explore knowledge pertaining to different domains that need to be shared because this is where the skills need to be applied. Furthermore, in order to illustrate the skills contributing to knowledge sharing in a more comprehensive manner, it is also necessary to explore and build further relationships between the skills and the knowledge domains. Therefore, the research objectives are presented as follows:

1) To identify and explore different domains of knowledge that project managers need to share in their practice in the construction industry;
2) To identify and explore different skills that support project managers to share the required knowledge;
3) To explore relationships between the skills and the knowledge domains, in terms of which skills help to share which knowledge domain and what dimensions of those skills are useful in the sharing;
4) To develop an integrative framework to conceptualise and explain the relationships between skills and knowledge domains within the context of a construction project.

1.3 Thesis structure

This introduction chapter presented the research context and background, defined the research question and objectives, and outlined the expected theoretical and practical contributions of this study.

Following the introduction, Chapter 2 elaborates on the existing literature with the aims of relating the research question to the existing body of knowledge, and developing theoretical and contextual sensitivity on the research topic. The main areas that are reviewed include knowledge sharing, the project context and participation of

project manager, factors influencing knowledge sharing, the concept of skill, and the contextual considerations of the construction industry in China. Knowledge sharing, as a central activity and dominant topic in knowledge management studies, has been investigated by researchers from a variety of perspectives. Yet the skills contributing to project manager's knowledge sharing practice within the construction industry need to be further explored, especially with an integrative approach to relate the skills to the specific knowledge that they help to share. This thesis seeks to contribute to knowledge by identifying the required skills together with proposing an integrative framework illustrating the specific relationships between the skills and knowledge domains that need to be shared.

The methodology chapter, Chapter 3, serves the purpose of operationalising the research objectives from methodological perspectives. To answer the research question and achieve the research objectives, the underlying philosophical worldviews and research strategies in social science studies are explained, followed by a justification and rationale for the approach and strategies adopted by this research. Due to the interpretive, exploratory and inductive nature of this study, the Grounded Theory methodology together with a case study approach is selected to conduct this investigation. Grounded Theory is the main methodology that guides data collection and analysis procedures; case study is the research strategy which provides the appropriate and practical context where the data is collected. Along with this choice, a qualitative, semi-structured interview method was adopted in a single five-star hotel project as the research setting, composed of three participating organisations, located in Xingtai City, Hebei Province, China. To analyse a total of twenty-one interviews conducted within this case project, the data analysis techniques adopted in this study include constant comparison and two stages of coding from the Grounded Theory methodology. This provides guidelines on the conceptual process from data to theory development.

The findings obtained from following the selected methodology are then presented in Chapter 4. The chapter is structured around the two parts of the results emerging from the data, which also respond to the first two research objectives. For the first part, five knowledge domains that need to be shared by project managers are identified. They

are knowledge of risk, planning, implementation, people, and strategic and operational knowledge. These knowledge domains are largely aligned with the three phases of the project, and are of a dynamic and inter-relational nature. The second part of this chapter centres on three sets of skills, as suggested by the data, that assist project managers in their knowledge sharing practice. Social cognitive skills focus on interpreting the meanings from individuals and reaching mutual understandings; interpersonal skills contribute to create a positive environment for knowledge sharing; and strategic orientation skills are concerned with addressing conflicts and highlighting common interests among participating organisations and stakeholders both strategically and collaboratively.

Chapter 5 provides a discussion on the findings and evaluates these against the existing literature. It begins with a discussion on the relationships between the first and second parts of findings i.e. the relationships between knowledge domains and skills contributing to knowledge sharing. This is supported by the research data and relevant literature, and responds to the third research objective. An integrative framework is then developed in order to integrate and conceptualise the findings in this study; this also achieves the last research objective. The integrative framework contains three individual dimensions, namely, the three phases of a construction project, five domains of knowledge that needs to be shared throughout the three phases, and three sets of skills that contribute to share the required knowledge. The framework also contains two areas of interactions indicating the inter-relationships between knowledge domains and project phases, and between knowledge domains and skills. Furthermore, the integrative framework indicates a dynamic and inter-relational nature of the knowledge domains and skills; it also illustrates multiple perspectives that are brought along by the positionality of different actors and stakeholders within the project. Subsequently, the integrative framework is discussed against the current literature, which illustrates that studies to date have focused on either the knowledge domains or skills without an integrative approach; this study suggests the existence of specific and important relationships between them.

This leads on to the contributions and implications discussed in Chapter 6. This chapter begins with summarising this study and responding to the research question and

objectives, with a focus on its contributions to knowledge. The contributions are then converted to four theoretical implications. These include providing an integrative approach to identify and combine knowledge domains and skills within one construction project; illustrating a dynamic nature between knowledge domains and skills through their interactions in knowledge sharing practice; indicating an inter-relational nature between knowledge domains and skills by establishing specific relationships between them; and providing multiple perspectives and interpretations according to various positions and stakeholders within the project. Practically, this study can be used not only for project managers in their knowledge sharing activities but also by organisations for human resources management and training purposes. Finally, this concluding chapter acknowledges the limitations within this study and identifies potential directions for future research.

Chapter 2: Literature review

2.0 Introduction

The literature review focuses on theoretical considerations of knowledge sharing and the participation of project managers, and on contextual considerations of the construction industry in China, where this research is conducted. The four main elements for this research topic are knowledge sharing, project manager, construction industry and China, as described in Figure 2.1. In this study, knowledge sharing and the role of project managers are considered as two main themes, while construction industry and China are regarded as the context for the research. Accordingly, the reasons and aims for the literature review chapter are i) to enhance theoretical understanding towards the research topic and to increase the researcher's theoretical sensitivity (Sections 2.1 – 2.5); ii) to gain general knowledge of the research context and to develop the researcher's contextual sensitivity (Section 2.6); iii) to further align this research with the gaps in the current literature (Sections 2.7).

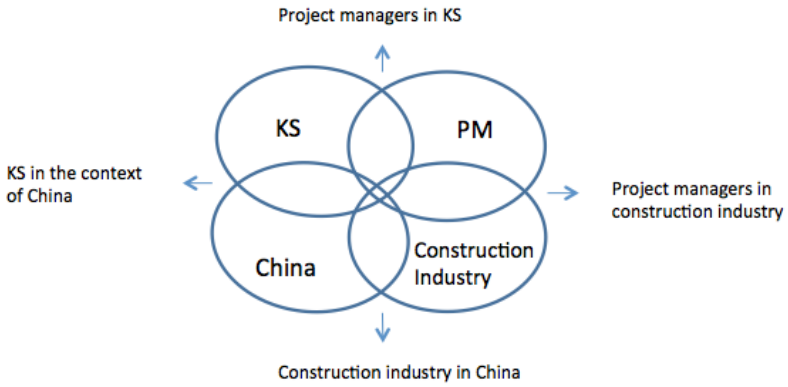


Figure 2.1: Different elements of the research topic

The first five sections in this chapter are focused on theories and studies regarding to knowledge sharing. It follows a top-down structure, with the first section focused on broad-level discussions about the following terms: knowledge; knowledge management; and knowledge sharing. The second section then narrows down the context to knowledge sharing practices in projects; this is then followed by the involvements of project managers in the third section. The fourth section is concerned with technological, organisational and individual factors that influence knowledge

sharing, and relating them to the project setting. Finally, the concept of skill in different research contexts, especially in knowledge management and project management, is discussed in the fifth section.

The sixth section focuses on the contextual considerations regarding how the context of construction projects and China influence knowledge sharing. The knowledge sharing concepts and factors are generally applicable in the Chinese context; meanwhile, China as a country with a significantly different culture to western countries has some unique characteristics in its business and political environment. To indicate and explain these factors and characteristics, this part of the literature review is divided into three sub-sections: knowledge sharing in construction project context; the development and current situation of the Chinese construction industry; and the Chinese context for knowledge sharing.

Finally, the last section summarises the literature review and indicate its implications to this study.

2.1 Knowledge and knowledge sharing

2.1.1 Knowledge and knowing

The earliest discussion of knowledge originated from the ancient Greek times when Socrates and Plato defined knowledge as “true belief”; the objects of knowledge must be infallible, completely real and unchanging (Cornford, 2003). In academic studies nowadays, there are various definitions and understandings towards knowledge (Barley, Treem, & Kuhn, 2017), as the perspectives differ in diverse study areas in terms of how knowledge is observed (Alavi & Leidner, 2001). In general, knowledge is considered as both a dependent and independent variable, which has been a major research focus of different disciplines such as philosophy, information and library science, sociology, business, economics and organisation management (Foss, Minbaeva, Pedersen, & Reinholt, 2009). Through the analysis of knowledge application, Nonaka (1994) modified the ancient definition and suggested that the traditional emphasis of “truthfulness” could be viewed as a dynamic process of justifying personal belief for current purposes. He defined knowledge as “justified personal belief” which combines both the fact or experience and the personal justification or understanding.

In this sense, knowledge becomes something abstract in people's mind that combines the subjective facts and individual objective understandings. This makes the sharing of knowledge become meaningful because even for the same event, different people have their own opinions and benefit from sharing distinguished knowledge.

Over the past several decades, in organisational studies and knowledge management research, knowledge has been explored and recognised both in differentiation and integration (Barley et al., 2017). For the stream of differentiation, knowledge is regarded and classified into different types for both research and practical purposes. This perspective is described as 'taxonomic' by Tsoukas (1996); he argues that researchers seek to classify organisational knowledge into different types and draw out each type's implication in terms of strategies and techniques. For instance, organisational knowledge has traditionally been distinguished by its place on a hierarchical ladder together with data at the bottom level and information at the middle level: data are the sensory symbols that people receive in organisations; information is the processed data and therefore, is meaningful to its recipient; knowledge is the learned and evaluated information existing in individuals (Alavi & Leidner, 2001; Tian, 2017). Knowledge therefore adds meaning to data and information by providing selectivity and judgement, and it exists as one of the most valuable assets in the organisation (Aktharsha, 2011).

Polanyi (1969) suggested the different forms of explicit and tacit knowledge. Many scholars start developing the classification from the distinction between explicit knowledge and tacit knowledge: explicit knowledge, described as "*know what*", is the technical or academic information that can be easily codified and collected; tacit knowledge is about "*know how*" and "*knowing more than we can tell*", personalised in individual's minds and fitting its particular environment and therefore, more valuable and difficult to access (Fullwood & Rowley, 2017). Explicit knowledge is usually presented in the form of blueprints, manuals, policies, production schedules, market intelligence data, requirement lists, etc. (Schoenherr, Griffith, & Chandra, 2014). It can be easily written down in certain symbolic forms or articulated in languages (Newell, 2015). In comparison, tacit knowledge can hardly be written down; even if being written, it cannot usually be understood without explanation or common knowledge as

the basis (Newell, 2015). Anand and Singh (2011) further catalogued the "know how" knowledge into tacit and implicit, stating that although both of them exist in the human mind, the tacit knowledge is only accessible through knowledge elicitation and behaviour observation while the implicit knowledge is easier to access via group discussion. Tacit knowledge is implicit, subjective, embedded in individual experience and evidenced in behaviours (Schoenherr et al., 2014). McInerney (2002) summarised the differences between explicit and tacit knowledge in detail, as shown in Table 2.1.

Implicit or tacit knowledge	Explicit knowledge
Subsconscious	Formally articulated
Perceived	Elucidated
Unaware	Aware
Difficult to articulate or unspoken	Fixed
Experienced based	Codified
Transferred through conversation	Documented (written, taped, recorded, digitalised, etc.)
Embedded in stories and narratives	Stored in repositories (databases, files, etc.)
Escapes observation	Can be viewed or heard
Held within self	Shared with others
Personal	Organisational
Insights and understandings	Pushed or pulled
Judgments	Reports, lessons learned
Assumptions	

Table 2.1: Differences between explicit knowledge and tacit knowledge (McInerney, 2002)

While both the explicit and tacit knowledge are important, discussion on tacit knowledge stands out in knowledge management theories and models (Johnson, 2007). Tacit knowledge provides more competitive differentiation (Schoenherr et al., 2014). Due to its characteristics, tacit knowledge is viewed as closely connected to organisational success and innovation (Kucharska & Kowalczyk, 2016). It is closely related to organisational efficiency and innovating, which are two fundamental elements that enable an organisation to compete (Newell, 2015). This typified classification between explicit and tacit creates debate on an important aspect of the

dynamic nature of knowledge, i.e. whether and how the tacit knowledge can be effectively converted into explicit knowledge which could be easily shared among groups and even across time and space (Lindström, Delsing, & Gustafsson, 2015). For example, Brown and Duguid (1998) suggested that the core competency of an organisation relies on more than merely explicit knowledge; it requires "tacit know how" to put the "know what" into practice. Nonaka (1994) compared the different attitudes of westerners and Asian people towards different types of knowledge, stating the former tend to prefer explicit knowledge while the latter turn more towards tacit knowledge. The greater difficulty in managing knowledge in an Asian context is mainly due to a large amount of tacit knowledge.

Despite the distinction between explicit knowledge and tacit knowledge, sometimes it is not easy to merely distinguish knowledge according to the strict classifications, especially when considering the fact that knowledge has a dynamic nature as it is constantly changing through experience and learning (Tuan, 2017). As argued by McInerney (2002, p. 1010), "*knowledge is not merely an object that can be 'placed', nor should it be confused with representations of knowledge in documents, data bases, etc., but it can be seen as a collection of processes that allow learning to occur and knowing to be internalised*". This shows that the explicit and the tacit cannot simply be separated by identifying the explicit as something written in documents and the tacit as a constantly evolving issue or condition. Instead, they are closely associated and can be used to define each other. Most researchers tend to agree that both explicit and tacit knowledge are commonly used especially in knowledge intensive businesses (Heisig et al., 2016); there isn't an obvious line or gap between them. Fullwood and Rowley (2017) also argue that the explicit and tacit knowledge are mutually constituted rather than in separation.

As well as the concept of knowledge, the notion of knowing is important and of interest. The underlying assumptions made by researchers are that knowledge can be viewed from two opposite perspectives. The first of these is to view knowledge as separate entity, stable property or static object embedded in individuals, and enacted in people's everyday practice (A. C. Edmondson & Harvey, 2017). In the second view, knowledge is considered to have a dynamic nature, changing, being used and

accumulated in practice. Polanyi (1969, p. 132) defined that "*knowledge is an activity which would be better described as a process of knowing*". Knowing is about obtaining and applying the knowledge in practice and action; knowledge can be considered in the sense of a stock with dynamic nature and knowing in the sense of a process (Orlikowski, 2002). This conceptualisation indicates that "*tacit knowledge is a form of knowing and thus inseparable from action because it is constituted through such action*" (Orlikowski, 2002, p. 251). Current studies emphasise the significance of tacit knowing in terms of strategies, competitive advantages, learning and innovation (Mcadam, Mason, & McCrory, 2007). Tacit knowing as a process, enables knowledge, especially tacit knowledge, to be developed within individuals and to be shared organisationally (Johnson, 2007).

The transition from experience to knowledge involves three phases of knowledge creation, retention and transfer (or sharing), explained by Argote and Miron-Spektor (2011). Knowledge creation occurs when a unit generates new knowledge to its original circle, which highlights the importance that experience contributes to creativity and innovation; knowledge retention refers to the stock and flow of the existing knowledge inside an organisation or project, which is also known as the reuse of organisational memory; the capability of knowledge retention includes discovering and reusing the knowledge embedded in organisational members, tools, tasks, practice and the formed networks. In company practice and application, knowledge is viewed as being embedded in three basic organisational elements – members, tools and tasks (Wan, Li, Gao, Roy, & Tong, 2017). Members are the human components, the organisational staff who carry knowledge in themselves; tools, as technical components, are the computerised systems that codify, store and transfer knowledge; tasks indirectly reflect the common goals that are agreed and perused by organisational members (Argote & Ingram, 2000). This raises awareness and discussion towards how to coordinate these three elements with the aim of identifying and utilizing the embedded invisible knowledge, i.e. how to manage organisational knowledge. In addition, Ramasamy, Goh, and Yeung (2006) suggest that there are three major knowledge sources available in organisations: internal knowledge that captures and leverages the knowledge crated within the firm itself; market contracts that embody the knowledge of market within its

product; and relational contracts which refer to both inter-organisational networks and individual strategic alliances between organisations.

To make the most use of knowledge and to create competitive advantages, the knowledge needs to be properly managed, allocated and shared.

2.1.2 Knowledge management

In order to understand knowledge sharing, it is important to first understand the main approaches and streams of knowledge management. As knowledge is believed to add value to an organisation and that all members can potentially contribute to the knowledge base within it, knowledge has been continuously viewed as a resource that needs to be managed, and thus the term 'knowledge management' has been widely discussed (Newell, 2015).

The definition of knowledge management can be classified into two streams, with the first stream focusing on processing single knowledge elements and placing different involved actions into the knowledge management lifecycle. Under this stream, knowledge management is considered as a method to systematically and actively process the creation, sharing, distribution, retrieval and application of knowledge (Razmerita, Kirchner, & Nabeth, 2014). The other stream focuses on knowledge as a whole being possessed by individuals and organisations, and the benefits of its application (Gasik, 2011). Under this stream, knowledge management is usually defined as the management processes of knowledge stock, flow and application in organisations (Foss et al., 2009).

Given the fact that organisational knowledge has been gradually recognised as a key factor in achieving organisational competitiveness, the management of knowledge is on the agenda in both academic discussions and organisational practises (Tzortzaki & Mihiotis, 2012). Through explicit and systematic management in terms of knowledge creation, collection, usage and exploitation, knowledge management assists organisations in enhancing organisational learning, improving internal communication, reducing the operational time-cycle and increasing innovations (Anand & Singh, 2011). Thus, knowledge management is considered as a key factor for organisations to achieve competitive advantages. Moreover, due to the fact that knowledge-based resources

are socially complex and usually difficult to imitate, the competitive advantages that knowledge-based management produces is long-term and sustainable (Fullwood & Rowley, 2017).

The effective management of knowledge, however, is not easy to achieve. One of the biggest concerns is that a large portion of organisational knowledge is still controlled by individuals (Razmerita et al., 2014), and leveraging this highly invisible knowledge relies on the willingness of the people who actually possess the knowledge (Choi, Kang, & Lee, 2008). Strategies for knowledge management have been focused on two key dimensions: the knowledge management focus, and the knowledge management source (Choi, Poon, & Davis, 2008). For the knowledge management focus, strategies for managing knowledge can be divided into explicit and tacit oriented; the former attempts to codify and reuse knowledge mainly through information technologies, and the latter adopts a personalisation approach to facilitate the face-to-face communication of tacit knowledge sources (Choi et al., 2008).

Inside an organisation, the most commonly mentioned strategy for bringing individuals' knowledge into the organisational context is through virtual communities of practice, enabled either by organisational sharing activities or online sharing technologies (Ardichvili, Maurer, Li, Wentling, & Stuedemann, 2006; Navimipour & Charband, 2016), i.e. through knowledge sharing. Knowledge sharing has been recognised as one of the most important methods for how organisational members learn from their colleagues to acquire new capabilities (Lee, 2001) and is a major focus with strategic importance to organisations (Navimipour & Charband, 2016). Learning occurs when the knowledge allocated in one part of the organisation is shared effectively to other parts and used effectively in providing solutions to problems (Goh, 2002). On the other hand, the lack of proper knowledge sharing in practice has turned out to be a major dilemma in efficient knowledge management in organisations (Ipe, 2003). Thus, knowledge sharing constitutes a key component in knowledge management.

2.1.3 Knowledge sharing

2.1.3.1 Knowledge sharing definitions

Heisig (2009) reviewed more than a hundred frameworks created from knowledge management research, and suggested that knowledge sharing is a dominant concept in this research area. The definition of knowledge sharing is given in a variety of ways (Yeşil, Koska, & Büyükbeşe, 2013). For example, Sharratt and Usoro (2003) viewed 'sharing' as an activity where a resource is given by one party and received by another. They defined knowledge sharing as a process where information is framed within a specific context by the knowledge of the source, and is being given out and received. During this process, what is received is "*the information framed by the knowledge of the recipient"* (p. 188). As a result, the shared knowledge becomes a joint-treasure between both the sender and the recipient. Similarly, Schauer et al. (2015) suggested that knowledge sharing is a type of social interaction which involves a two-way voluntary process.

Knowledge sharing is closely related to, and sometimes used interchangeably with, the terminology of knowledge transfer. Wang and Noe (2010) discussed knowledge sharing by comparing it with knowledge transfer: knowledge transfer refers to the sharing of knowledge from the knowledge source and the acquisition of knowledge by its recipient. This indicates that knowledge transfer involves and somehow includes knowledge sharing. Knowledge transfer, in Argote and Miron-Spektor (2011)'s definition, is concerned with indirectly acquiring knowledge from the experience of others, which typically occurs across boundaries of knowledge domains; the process of acquiring knowledge involves knowledge sharing. Knowledge transfer is more focused on the movement of knowledge between different units and places an emphasis on the different units, while knowledge sharing is more concerned with the provision of 'know-what' and 'know-how' knowledge itself (Wang & Noe, 2010). Knowledge sharing can be considered as one of the key mechanisms through which knowledge transfer can take place (Cabrera & Cabrera, 2005).

However, there are also researchers who suggest that the context of sharing is broader, not taking focusing on a specific location or position compared to knowledge transfer

(Henttonen, Kianto, & Ritala, 2016; Mueller, 2015). Knowledge sharing is a more complex activity beyond the mere transfer of abstract bodies of knowledge due to the extensive socially situated nature of knowing and sharing (Boland & Tenkasi, 1995); knowledge transfer is viewed as a key goal of knowledge sharing (Henttonen et al., 2016). More often, knowledge transfer takes place between large organisational entities or departments, while knowledge sharing could occur between individuals, or groups, and among various large organisations (Awate, Larsen, & Mudambi, 2015). Dyer and Nobeoka (2002) further indicate that knowledge sharing facilitates communities of people to work together, enables their exchange of knowledge and improves organisational learning capacity. Therefore, as a more complicated phenomenon than knowledge transfer, knowledge sharing refers more to knowledge-based activities and creates more competitive benefits for organisations.

There are two different schools of thoughts about how to share tacit knowledge, one suggesting to share tacit knowledge through making it explicit, and the other regarding tacit knowledge as always being tacit (Mcadam et al., 2007). In terms of different knowledge sharing types, it is generally classified into knowledge sharing between individuals and knowledge sharing between groups or organisations. Knowledge sharing between individuals is the process of converting the knowledge held by an individual into a form that could be obtained, understood and applied by other individuals (Yeşil et al., 2013). Consequently, it enables personal knowledge to be available to others within the organisation. Knowledge sharing between groups or organisations, places more of an emphasis on the provision of organisational task information and expertise, or 'know-how', on the basis of a particular product or procedure (Cummings, 2004).

Tuan (2017) suggested four mechanisms for knowledge sharing within organisations: 1) adding knowledge to the formal database in organisations; 2) sharing knowledge formally through interactions within or across teams; 3) sharing knowledge informally through communication; and 4) sharing knowledge through communities of practice. Thus, knowledge sharing between groups requires oral communications about organisational tasks, exchange of tangible information, the implicit coordination among experts and the information about who knows what in the group (Cummings, 2004).

2.1.3.2 Knowledge sharing motivations

Knowledge sharing is motivated and encouraged by various factors. Wang and Noe (2010) summarised the motivations into three categories, including: organisational context such as organisational structure and cultural characteristics; individual factors with regard to the employees themselves; and motivational factors of perceived benefits and costs. Many studies distinguish motivations based on the organisational context category and individual factors category, and explore motivations from both extrinsic and intrinsic perspectives (Almeida, Lesca, & Canton, 2016).

Extrinsic motivation encourages someone to perform an action because the action is perceived to be important, or even fundamental, in achieving valuable outcomes that differ from the action itself (Rode, 2016). It is an effective method to integrate employees within a team or within an organisation, which is critical for knowledge sharing (Hu & Randel, 2014). Effective knowledge sharing improves the efficiency in using resources, the speed in accessing important information and knowledge, and the inspiration of ideas (Caniëls, Neghina, & Schaetsaert, 2017). Learning occurs when knowledge in one part of the organisation is shared effectively with other parts and utilized in providing better solutions to problems and breeding creative insights (Goh, 2002). In this sense, knowledge sharing functions as an effective way to deploy organisational knowledge and to promote the process of transferring knowledge into competitive advantages for organisations. To encourage such knowledge sharing practices, extrinsic motivations adopted by firms include financial benefits and peer recognitions (Rode, 2016).

However, the extrinsic motivation may not be able to achieve the expected outcomes consistently because it is difficult to measure, evaluate and appraise the knowledge sharing, especially for the sharing of tacit knowledge (Hu & Randel, 2014). In addition, the results from some studies reveal that extrinsic motivation can sometimes actually reduce individual satisfaction in work performance (Sarin & Mahajan, 2001).

Intrinsic motivation focuses on the enjoyment and satisfaction during knowledge sharing, and therefore it contributes to consistently effective and lasting outcomes of knowledge sharing (Pee & Lee, 2015). The intrinsic motivation is more concerned with

the employees as individuals rather than the organisation as a whole. Employee's motivation is an important element for knowledge sharing. Indicated by McLure Wasko and Faraj (2000)'s study, an important reason why employees seek and share knowledge is to solve the problems that appear in their work, and those who have successfully solved problems via sharing knowledge with others are more positive in knowledge sharing practices. Namely, organisational knowledge as a dominant resource has been rendered by its capability of sustaining competitive advantages. In addition, the belief in knowledge from the knowledge owner is another driving factor for knowledge sharing. When employees believe they own particular knowledge, they are more willing to report that they would engage in knowledge sharing as they can gain internal satisfaction derived from the sharing (S. Wang & Noe, 2010).

Differences in knowledge can also be considered as a motivation for knowledge sharing. It refers to both different amounts of knowledge accumulated and different types of domain-specific knowledge accumulated (Carlile, 2002). Practice can create differences in level of experience, terminologies and motivations that are unique to a specialised knowledge domain (Carlile, 2002). When the two dimensional differences increase between organisational actors, the amount of efforts in sharing and accessing each other's knowledge also grows.

2.1.3.3 Knowledge sharing processes

In current literature, many discussions about knowledge sharing processes are conceptualized and presented by different models. A model is a representation of reality (Small & Sage, 2006). This sub-section reviews some of the typical models with the aim of comparing and analysing the knowledge sharing processes.

A Simplified knowledge sharing Process Model

Hendriks (1999) simplified and presented the process of knowledge sharing into two sub-processes, as shown in Figure 2.2. Knowledge sharing starts with the knowledge owners externalizing their knowledge, which can be achieved via different forms such as codifying in an intelligent system, showing and describing in person and explaining in a lecture. The second process is the knowledge 'reconstructors' receiving the knowledge and internalizing it. The process of knowledge sharing can be either explicit

or tacit (Navimipour & Charband, 2016). Such knowledge sharing practice could be accomplished through either face-to-face communication between knowledge owner and recipient, or technical platforms where the knowledge owner codifies relevant knowledge for the recipient to retrieve. Reflecting the simplified model on the topic (project managers' knowledge sharing practice) of this study, the project managers in the construction project act the role of knowledge owners when they share knowledge with their team members, while performing as knowledge recipient when they receive knowledge from other managers. Therefore, the project managers can be considered as both the knowledge owner and knowledge recipient within the project. The details of how different project managers interact and share knowledge will be discussed in Section 2.3.

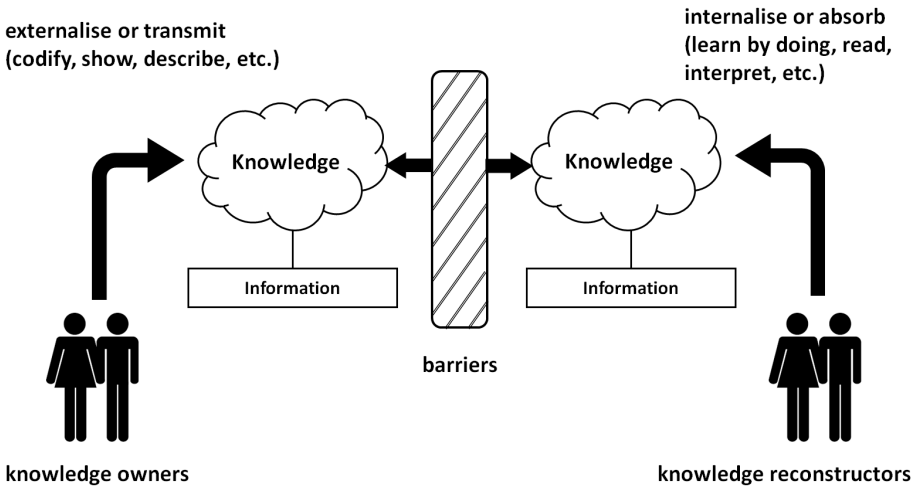


Figure 2.2: A Simplified Knowledge Sharing Model (Hendriks, 1999)

As shown in Figure 2.2, an invisible wall of barriers exists during the knowledge sharing processes, which hinders the knowledge flow between owner's externalisation and recipient's internalisation of knowledge. Some of the barriers are unconcealed such as time and space, while some are constitutive such as culture and conceptual frames (Hendriks, 1999). The knowledge sharing factors, including barriers, will be further discussed in Section 2.5.

The simplified knowledge sharing Model provides an overview of the basic knowledge sharing procedures. However, the sharing of knowledge between knowledge owners and 'reconstructors' are affected by many factors including individual capabilities, preference and organisational context, which are not presented in this model.

Knowledge Creation Model and knowledge sharing

Nonaka, Toyama, and Konno (2000) developed a knowledge creation model (also known as SECI) which assumes that knowledge can be transformed freely between tacit and explicit states. He described the creation of organisational knowledge in four different modes (socialisation, externalisation, combination, and internalisation) of knowledge conversation as shown in Figure 2.3. The four modes represent knowledge conversation from tacit to tacit, from explicit to explicit, from tacit to explicit and from explicit to tacit respectively. Each phase involves the interaction between tacit knowledge and explicit knowledge, through which the organisational knowledge is created and shared.

Socialization is a mode of knowledge interaction that enables tacit knowledge to be shared and converted through communications between individuals (Nonaka et al., 2000). It is important to note that an individual can acquire tacit knowledge without language; for example, managers engage in experience through actual practice (Nonaka et al., 2000). The socialisation provides the basis for the externalisation mode of knowledge where explicit knowledge itself combines with other explicit knowledge before being internalised by individuals (Lievre & Tang, 2015). Externalization is the process of transferring tacit knowledge in one person to explicit, making it easier for others to understand. Depending on sharing experience and resulting in acquired skills, this procedure involves capturing knowledge through direct interaction between people both outside and inside the organisation (Nonaka, 1994). This is the most common situation where knowledge sharing happens. Combination, as the mode from explicit to explicit, refers to the use of social processes to combine different bodies of explicit knowledge held by various individuals; for instance, managers assemble internal and external data by using published literature, phone conversation with employees and computer simulation in order to make better strategies (Nonaka et al.,

2000). The phases of externalisation and combination can be complex and time consuming, especially when the context of knowledge sharing is affected by cultural differences (Lievre & Tang, 2015). In the end, the explicit knowledge is understood and absorbed by individuals as tacit knowledge, noticed as the mode of internationalization (Nonaka, 1994).

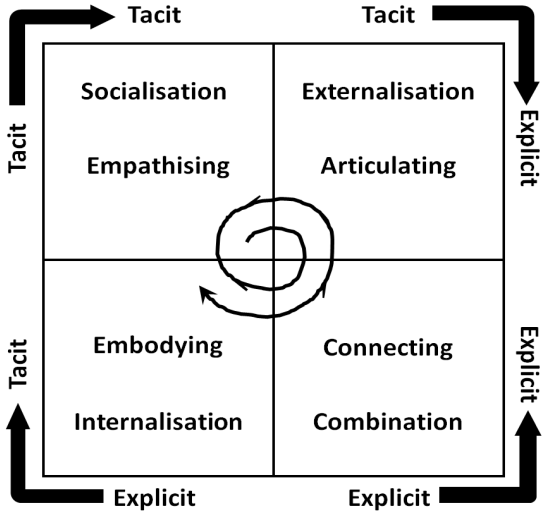


Figure 2.3: Enterprise Knowledge Creation Model (Nonaka et al., 2000)

The SECI model is widely discussed in knowledge management research, including relating the model to knowledge sharing in organisational management (Zhang, Zhao, & Wang, 2016), discussing organisational culture and knowledge management (Rabelo et al., 2015), and adopting it in information technology development (Chatti, Klamma, Jarke, & Naeve, 2007). Small and Sage (2006) explored and connected knowledge sharing with the knowledge creation model, and pointed out that knowledge sharing mainly occurs in the socialization, externalization and combination phases. Their arguments are reflected in Figure 2.4. In the stage of socialization, knowledge is shared at the individual level, as it is about face-to-face communication with customers and suppliers outside the company and with internal staff (Small & Sage, 2006). In the externalization and combination phases, knowledge sharing occurs at organisational level and sometimes between different organisations. The knowledge holders create concepts to externalize their knowledge and make it available for the organisation in

the externalization phase; knowledge receivers in the organisation justify the created concepts and build models to combine the explicit knowledge in the combination process. Inter-organisational knowledge sharing also happens in the combination stage, sharing the "cross-levelling knowledge" in the framework (Small & Sage, 2006).

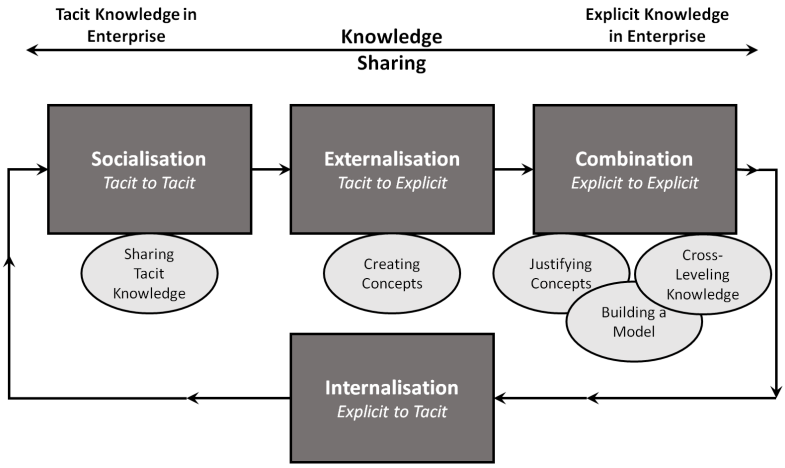


Figure 2.4: Knowledge Sharing and Enterprise Knowledge Creation Model (Small & Sage, 2006)

The SECI model conceptualises and summarises the knowledge generation and flow from a general perspective. Knowledge sharing, as an important tool and component of flowing knowledge and generating new knowledge, is not directly presented in this model. However, through further exploration and discussion of this model, a general view and idea can be gained of where and how knowledge sharing is functioning in the whole knowledge process. In addition, not all scholars agree that all forms of knowledge can be converted and transferred from one another, especially from tacit knowledge into explicit knowledge, as much of the richness and potential value of knowledge will be lost during the conversion and sharing process (Huang, Davison, & Gu, 2008; Jin-Feng, Ming-Yan, Li-Jie, & Jun-Ju, 2017).

Knowledge sharing between Organisational Individuals

Ipe (2003) analysed the organisational knowledge sharing behaviours between individuals, as presented in the individual knowledge sharing framework in Figure 2.5. Knowledge sharing between individuals is the process of converting the knowledge held by an individual into a form that can be understood, absorbed and used by other

individuals (Ipe, 2003). In Ipe's framework, knowledge sharing is driven by, and depends on, three key factors: the nature of knowledge; the motivation to share; and the opportunities to share. The nature of knowledge can be classified into tacit and explicit, which has been discussed in Section 2.1.1. Knowledge with different natures is shared through different methods, for example the tacit knowledge could be shared through personal communication while the explicit knowledge is shared via codification. In addition, the value of knowledge, such as its commercial and scientific value, also affects the way of sharing (Ipe, 2003). The motivations of sharing, which were discussed in Section 2.1.3.2, consist of internal motivation i.e. the "perceived power" attached to the knowledge, and external motivation i.e. the relationship and reward system between knowledge sender and recipient (Ipe, 2003). The opportunities to share relate to elements such as organisational training programs and technical systems. All three factors are embedded within the culture of the working environment and are interrelated with each other, together creating and promoting knowledge sharing between individuals in the organisation.

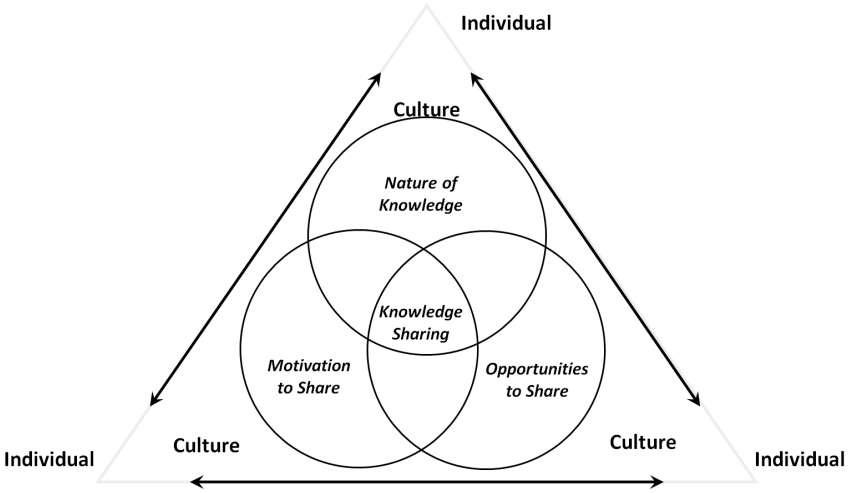


Figure 2.5: A Model of knowledge sharing between Individuals in Organisations (Ipe, 2003)

Understanding knowledge sharing behaviours between individuals helps towards gaining a better understanding of the integrated knowledge sharing in organisations. The model of knowledge sharing between individuals in organisations has expanded the simplified knowledge sharing model, and explored the reasons and motivations for knowledge sharing. Whereas this model is lacking solutions on how to combine and

use these motivations to constitute better skills for knowledge sharing so that organisations and managers could promote their knowledge sharing practices.

Multiple Networks and Multiple Phases in knowledge sharing

Hansen, Mors, and Løvås (2005) analysed the effects of different social networks on the outcomes of different phases in knowledge sharing. As presented in Table 2.2, they placed the social networks into three subsets: established relations between members working in the same team located within a subsidiary (a within-team network); a team's total relations with those in other subsidiaries, regardless of whether they transfer knowledge among one another (an inter-subsidiary network); and a team's "dyadic relations" involving only gaining knowledge from other subsidiaries via knowledge sharing and knowledge transfer (a transfer network).

Subset of Social Network	Relational Variables	Outcomes
Within-team network	Size	Sought Knowledge
	Strength	
Inter subsidiary network	Size	Search Cost
	Strength	
	Competition	
Transfer network	Competition	Transfer Cost
	Strength	

Table 2.2: Social Networks on Outcomes of Three Phases of knowledge sharing (Hansen et al., 2005)

Inside an organisation, knowledge is distributed among employees as individuals, and therefore the use of teams can contribute to integrate knowledge and facilitate knowledge sharing (Alsharo, Gregg, & Ramirez, 2017). When a team searches for knowledge, they would start with solving a problem by interacting and sharing knowledge with team members, i.e. within-team network knowledge seeking (Hansen et al., 2005). As shown in the table, the higher the density and average strength of a within-team network relation is, the less likely the team will seek knowledge across subsidiaries. The within-team network could channel team members' time and energy,

while team's relations in the inter-subsidiary network may pull it outward (Hansen et al., 2005). In this sense, teams sometimes tend to search knowledge from the outside.

In this model, the larger a team's inter-subsidiary network is and the more frequent and intense interactions have been, the more opportunities there would be for solving problems. However, this phase could incur search costs, and the higher relations the inter-subsidiary network has, the higher the search costs will be. When a team has found useful knowledge from other subsidiaries, the process of modifying, editing and incorporating the knowledge into the team's product will be conducted (Hansen et al., 2005). A knowledge transfer cost is involved; the more a providing subsidiary perceives that it competes with the knowledge receiving team, the higher the transfer cost will be.

The existing models and frameworks on knowledge sharing processes are still quite disparate and isolated. Besides, the existing frameworks involve a lot of actions such as knowledge seeking, transferring and receiving. While the factor of people, especially for the questions of how to combine and structure the existing literature findings to better serve people-related requirements, and how to equip individuals with skills to share knowledge are rarely discussed. The attempts and efforts in identifying skills assisting project managers in their knowledge sharing practice in this research contributes towards filling this literature gap.

2.2 Knowledge sharing within the context of projects

2.2.1 Projects and knowledge sharing

The project-based organisation is becoming common and important in modern market (Brookes et al., 2006; Wei & Miraglia, 2017). A project is a activity among a group of people with a clear objective against a time scale; 'clear objective' means that every project has a specified and unique task and that people involved in the project are dedicated towards that task, and 'time scale' refers to the temporality of project, i.e. every project has a definite beginning and end date (Atkinson, 1999). In other words, a project has to be completed by a certain date, by a certain amount of money and with a certain level of performance (Munns & Bjeirmi, 1996). Compared to the companies relying only on daily operations that are ongoing and repetitive, project firms are more

efficient in responding to markets, executing new requirements and completing different tasks (Lampel et al., 2008); however, the project-based companies are exposed to more risks due to the characteristics of project such as limited time and unique tasks (Lampel et al., 2008).

A project acts as a portal or entrance that provides the opportunity to leverage and discover valuable knowledge in organisations (Wei & Miraglia, 2017). A project team is composed of members who usually belong to different functional departments within an organisation and are appointed to join the same project (Navimipour & Charband, 2016). The knowledge, especially tacit knowledge, inside the mind of project members and the organisation can be transformed and shared while completing the project (Brookes et al., 2006). Therefore, the activities being conducted in a project function as a path leading to organisational knowledge.

Compared to the bureaucratically structured companies where knowledge is easier to accumulate but harder to connect (Lampel et al., 2008), projects make it more convenient to access and transform the knowledge belonging to different departments inside one organisation or among multiple organisations. Moreover, in bureaucratic organisations, knowledge is always accumulated and controlled at management level, and the bureaucratic structure makes it very difficult to share knowledge, both across different hierarchical levels and among the staff in the same management level (Boh, 2007; Mueller, 2015). In project-based companies, knowledge is dispersed amongst people working on different projects (Wei & Miraglia, 2017); the project helps to break the wall of knowledge accumulation and promote decentralisation of organisational knowledge. Additionally, compared to organisations that only rely on daily operations, the project environment tends to create more new organisational knowledge and benefits from the inherently innovative nature of project tasks (Bresnen, Edelman, Newell, Scarbrough, & Swan, 2003). Daily operations always produce repeating products with the same knowledge, whereas each project has its unique task which results in new and fresh knowledge (Lampel et al., 2008; Mueller, 2015). Due to the characteristics of new products and new processes, the project environment is an inherent place for new ideas to emerge and cross-functional knowledge sharing to occur (Bresnen et al., 2003).

Project-based organisations, such as the construction and information software industry, consider knowledge management and sharing significantly important for project and organisational success (Mueller, 2012). Knowledge plays an important role in project teams by providing a link between participating members; the sharing of knowledge between project members also increases the performance and reduces cost (Navimipour & Charband, 2016). The knowledge that has been transformed from tacit to explicit is the most useful for project teams and project success (Oluikpe, 2015). Kucharska and Kowalczyk (2016) investigated knowledge sharing within project teams; their study reveals that knowledge sharing as a tool whilst conducting a project does not have a significant or direct influence on it's success, but it does have a significant indirect impact on it's overall performance. Knowledge sharing is important throughout the duration of a project. Each project starts with an interpretation, analysis and detailed consideration in terms of the project information and requirements; participants should be able to understand what the project is for and why the requirements are needed at the beginning, in order to deliver the project successfully (Oluikpe, 2015). Effective knowledge sharing allows project members to communicate and discuss the critical aspects of the project, obtain experience and learn lessons accordingly (Ghobadi & Mathiassen, 2016).

However, projects are often faced with knowledge sharing challenges and difficulties (Solli‐Sæther et al., 2015). Acting as a temporary type of organisational form, the project is also the context wherein knowledge relating to the involved permanent organisations can only be accessed and shared briefly (Aerts, Dooms, & Haezendonck, 2017). Project members jointly work together within a limited timeframe and then move on to different projects. After the completion of a project, team members are usually reallocated to different projects or units of the organisation without reflecting on the lessons learned for future work (Ekrot, Kock, & Gemünden, 2016). Furthermore, in project-based organisations people tend to ignore the common knowledge extracted from different projects due to the consideration that each project is relatively isolated from the others (Brookes et al., 2006). Hence, the knowledge in terms of solutions and ideas in one project might contribute to developing the routines and processes of the

entire organisation (Lampel et al., 2008). This conflict raises the necessity for managing and sharing project knowledge, which will be discussed in the following sub-sections.

Due to the characteristics of uncertainty, uniqueness and complexity of projects and project-based organisations, there has been an increasing focus on knowledge sharing within the project (Solli‐Sæther et al., 2015). To further understand knowledge sharing in the context of projects, studies are specifically conducted in either the same boundaries, i.e. within the project team or within the organisation as a closed research setting, or across boundaries which focus on two or more closed groups or organisations (Mueller, 2012). The following two sub-sections discuss the boundaries of projects and organisations in terms of knowledge sharing.

2.2.2 Intra and inter- project team knowledge sharing

Knowledge sharing in the context of projects can be generally classified into sharing knowledge inside one project and knowledge sharing across different projects. As defined by Desouza and Evaristo (2006), project knowledge management (and sharing) is the activity of leveraging the knowledge from best practices in terms of how projects are managed and what lessons have been learnt during the project. The management and sharing of such knowledge both inside a project team and across different projects contributes to the improvement of project performance (Desouza & Evaristo, 2006).

In order to achieve the best results, most project-based organisations emphasise the role of organising project teams in achieving efficient knowledge sharing activities and promoting individual knowledge sharing behaviour within the team boundaries (Mueller, 2014), i.e. intra-project team knowledge sharing. In contrast, sharing knowledge across project teams faces more challenges and difficulties due to the separation, in that each project team conducts their work independently (Mueller, 2015).

For a project-based organisation, knowledge is embedded in different projects (Desouza & Evaristo, 2006); the sharing and reuse of knowledge from different projects encourages and primes the organisational innovations, as the experiences from the past raise new ideas for products and services (Liebowitz & Megbolugbe, 2003). Reich, Gemino, and Sauer (2012) collected data from different project managers and

discovered that without mindful knowledge sharing practices, the documents generated during the project may not be aligned or support each other, and therefore may not enable business value to be created. The construction of a single project could always benefit from integrating and sharing the expertise, experience and knowledge from different specialisms (Reich et al., 2012). Besides, common problems can occur across different projects, although each project is customized and different from the others projects in several aspects (Cooper, Lyneis, & Bryant, 2002; Navimipour & Charband, 2016). The organisations that successfully share knowledge across projects and among individuals may find out that the knowledge and experiences from one project could frequently solve similar problems within another (Boh, 2007). Therefore, effective knowledge sharing between projects can reduce costs and time in making the effort of inventing the same solutions. This is especially true for the construction industry where the project work is the normal mode, and cross-project knowledge learning and sharing should be encouraged.

Lindner and Wald (2011) summarised these two types of intra and inter- project knowledge sharing as shown in Figure 2.6. They suggested that intra-project knowledge is strongly linked to project management methods and the communications within projects. The intra-project knowledge in the upstream of project A could be used for the downstream of project A. The knowledge from the upstream of both project A and project B – two different projects taking place at the same time – can be shared and used in their downstream. In addition, the knowledge from different projects (project A and project B) could be added to the total organisation knowledge. This model indicates how the knowledge can be managed and shared inside and cross project boundaries, and it also indicates the relationship between intra-project knowledge, cross project knowledge and project-based organisational knowledge.

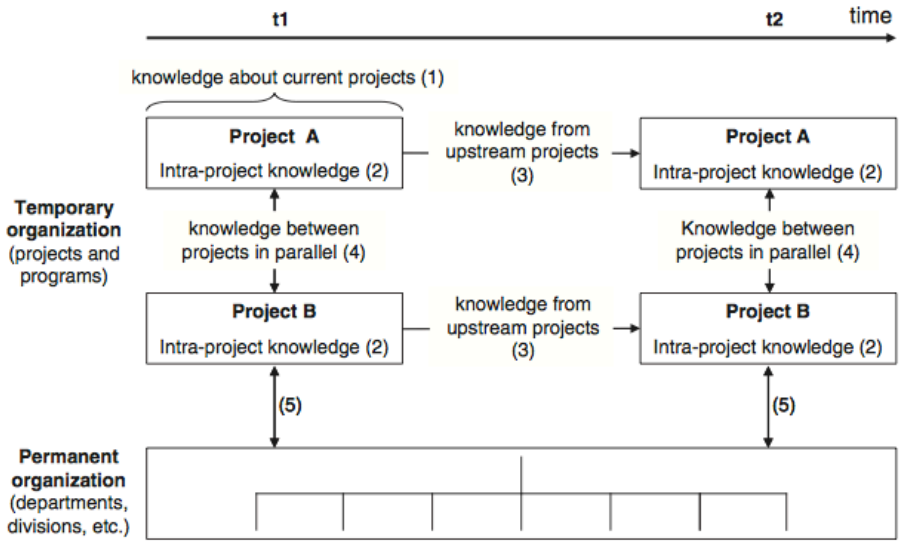


Figure 2.6: Knowledge management in project organisations (Lindner & Wald, 2011)

Despite various forms and practices of sharing knowledge, it is still difficult to achieve the expected results from project knowledge sharing. One explanation is that in a pure project-based organisation, the projects embody most of the business functions and organisational knowledge which are normally carried by departments in functional or matrix organisations (Prencipe & Tell, 2001). As indicated by Cooper et al. (2002, p. 213), "*we have yet to discern how to extract and disseminate management lessons as we move from project to project*". Besides, knowledge in different projects varies in form, location, professional area and participants. Projects and project-based organisations need to share knowledge very effectively if they want to learn from and apply their experiences to future projects (Navimipour & Charband, 2016).

In practice, the types of project vary in different industries. Some projects can be completed within one single organisation, while others require corporation between several companies. For a construction project, which is the context for this research, each single project involves contributions from different organisations. Therefore, the knowledge sharing inside organisations and across organisational boundaries are both important. To better understand these two types of knowledge sharing practices, the next sub-section discusses both intra-organisational and inter-organisational knowledge sharing.

2.2.3 Intra and inter- organisational knowledge sharing in project

Boundary usually refers to the issue of “inside” and “outside” of an organisation (Paraponaris & Sigal, 2015). Sharing knowledge within and across organisational boundaries is a widely discussed area in knowledge management studies. A project can sometimes involve more than one organisation, and the knowledge sharing activities involve stakeholders beyond an organisational boundary (Newell, 2015).

Intra-organisational knowledge sharing is the sharing of knowledge inside one single organisation. With the increasing attempts and adoptions in using internal knowledge in organisations, intra-organisational knowledge sharing between individuals and across different units within enterprise become common and provide competitive benefits (Van Wijk, Jansen, & Lyles, 2008). It is a key process in organisational knowledge management, and can improve the job satisfaction of employees (Kianto, Vanhala, & Heilmann, 2016).

Inter-organisational knowledge sharing, also known as external knowledge sharing or sharing knowledge across organisational boundaries, is defined as the exchange of information, “know-how” and feedback among customers, experts and other people outside the organisation or group (Cummings, 2004). Since knowledge is usually developed inside organisations and assists in gaining competitive advantages, different organisations have their advantages through their own expertise. Consequently, it is important for organisations to process their capability of learning from others with the aim of achieving success in the increasing pace of competition (Easterby-Smith & Lyles, 2011).

To better manage and share knowledge across boundaries, Carlile (2004) proposed a framework to describe three types of complex boundaries, namely syntactic, semantic and pragmatic, and to discuss the management of knowledge across these boundaries via transferring, translating and transforming. Transferring knowledge is a common label used to describe the movement of knowledge from one to another, as the concept of ‘transfer’ has its root in mathematical approach and is based on information processing approaches (Carlile, 2004). Given its technical foundations, knowledge transfer in the framework is used to manage the syntactic or information-processing

level of knowledge which has the primary focus on knowledge storage and retrieval. Translating knowledge is used when the transition from a syntactic to a semantic knowledge boundary occurs, i.e. when there is a need to generate interpretive differences and create shared meanings. The distinction between explicit and tacit knowledge, and discussion on the 'stickiness' of situated knowledge also tends to happen at this level of knowledge translating. Transforming knowledge is used at the highest level when actors have different interests, but common interest needs to be developed. Under this circumstance, semantic boundary transmits a pragmatic boundary and the domain-specific knowledge as well as common knowledge which needs to be transformed in order to be effectively shared and assessed. Carlile (2004)'s framework addresses sharing and managing common lexicon, common meanings, new agreements and common interests among different actors.

Knowledge sharing inside organisations and among different organisations is interrelated. The learning and sharing of knowledge from external companies can promote and enrich the content and motivations for intra knowledge sharing, and in turn, intra-organisational learning and sharing practices accelerate the speed and efficiency of inter organisation learning and sharing (Holmqvist, 2004). Therefore, a balanced combination of both intra and inter organisational knowledge sharing is critical for successful organisational knowledge sharing and knowledge management, especially for organisations which are involved with heavy knowledge flow and frequent interactions and communications with their counterparts.

This research is conducted in the context of the construction industry where the three individual organisations – the investing company, the design institution and the construction company – interact with each other while at the same time share knowledge inside their own firm (will be presented in Section 3.3.2). Therefore, both the intra and inter organisational knowledge sharing practices are important for construction projects.

2.2.4 Knowledge domains in projects

To further relate back to the research question and objectives, this sub-section reviews different knowledge domains that are identified in existing studies and are considered as important in the context of projects.

The terminology of knowledge domain is defined, in educational research, as an understanding of a basic concept, its goals, rules and principles (Chiesi, Spilich, & Voss, 1979). In knowledge management research, Nonaka et al. (2000)'s SECI model is widely discussed with a focus on 'how' knowledge is converted between explicit and tacit within organisations, as discussed in Section 2.1.3.3. Nonaka and Toyama (2003) suggest that knowledge is created by the synthesis of the contradictions between the organisation's internal sources and the environment. Therefore, the knowledge can be viewed as two different domains; the domain of 'real' where generative mechanisms reside, and the domain of actual and empirical in which observed and experienced events are contained (Nonaka & Toyama, 2003). A separate area of work that has been conducted is with regard to 'what' kinds of knowledge, or what specific domains of knowledge, are converted and shared (Byosiere & Luethge, 2008). A domain here relates to a specific content area of knowledge or practice with knowledge involved (Byosiere & Luethge, 2008). Different domains of knowledge and practice can be communicated and shared when there is a common understanding or a common language between organisational members (Swan, Bresnen, Newell, & Robertson, 2007). In this research, the adoption of the term knowledge domain rather than knowledge area or type refers to the fact that this study is aimed at exploring all potential knowledge that needs to be shared, including both the knowledge itself and the knowledge with practice involved. Therefore, the usage of the term domain provides a clearer explanation and wider context to include the knowledge pertaining to, or contributing to, a domain of practice.

Four knowledge domains are summarised from the review, including knowledge of business value, procedural knowledge, managerial knowledge and experienced expert knowledge shown in Table 2.3. Overall, knowledge of business value refers to understandings of project goals and values that are expected to deliver; the other three knowledge domains provide supports in the achievements of the goals and values.

Knowledge Domains	Definition	Explanation and Example	Reference E.g.
Knowledge of Business Value	The understanding of project objectives that the project expected to deliver, and of whether the current carry-on work can lead to those objectives and to achieve business value.	In general, there are three aspects and levels in this knowledge area: i) knowledge about the known goals of the project; ii) knowledge about understanding and achieving unfamiliar goals; iii) knowledge about switches cognition between the known and unknown. E.g. Knowledge of short-term goal of the project, such as project to be completed within time and budget; Knowledge of long-term goal of the project, such as the constructed building can last for over 100 years.	Reich et al., 2012; Mccormick, 1997; Ajmal et al.,, 2010; Mousavizadeh , Ryan, Harden & Windsor, 2015; Oluikpe, 2015; Herbst, 2017;
Procedural Knowledge	Awareness and understanding of “how to do” and “how to act” throughout the project procedures, in order to meet project goals and business value.	It is deployed in project processes, and usually concerns about the producing and the using of project outputs. E.g. Knowledge of project solutions if there are changes (changes to structure, processes, culture, etc.); Reduced waiting time; Problem solving.	Kasvi et al, 2003; Reich et al., 2012; Macormick, 1997; Lech, 2014; Mueller, 2015; Lampel et al., 2008;
Managerial Knowledge	Generic management knowledge in conducting projects, in order to facilitate	This area of knowledge is embedded and institutionalized in conducting, managing and directing project processes.	Edum-Fotwe & McCaffer, 2000; Lampel et al.,

	better project performance, as well as to meet project goals and business value.	E.g. Knowledge of strategic thinking; Knowledge of contract management.	2008; Macormick, 1997; Lech, 2014
Experienced Expert Knowledge	Key experience-related and profession-associated knowledge that has general business relevance for future or other projects.	This type of knowledge involves project managers' previous experience and professional proficiency. E.g. Lessons learned; Techniques in using different tools; Knowledge of regulation and construction supervision	Schindler & Eppler, 2003; Reich et al., 2012; Ghobadi & Mathiassen, 2016; Chan, 2016;

Table 2.3: Knowledge domains need to be shared (Li et al., 2017)

Knowledge of business value, regarding to project goals and aims, is a critical element that influence the project performance and guide the direction of project development (Li et al., 2017). This knowledge domain has a strong characteristic of being dynamic because the understanding towards business value is an evolving process; it can be modified and even changed throughout the project lifecycle (Reich et al., 2012). As indicated in Table 2.3, knowledge of business value consists of three different levels, including the level of the known goals, the level of understanding how to achieve the unfamiliar goals; and the level of cognition that switches understandings between the known and the unknown. This knowledge domain plays an important and leading role within the project. Project participants with a mutual interpretation and understanding towards the value of business also tend to share other domains of knowledge more effectively (Oluikpe, 2015). Project managers are responsible for leading the project team and managing project activities, and therefore should share knowledge about business value and ensure this knowledge is understood effectively.

Procedural knowledge is about solutions and the "know-how" knowledge embedded within the project process. It helps project participants in problematic situations by

providing knowledge of “how to act” (Reich et al., 2012). For example, in a construction project, it is important to communicate the standardised procedures and templates; however, this type of knowledge usually needs to be combined together with solutions or specific interpretations of the situation. This combines both knowledge about the particular situation and a reflection of previous work experience for similar situations. It contributes to deploy the knowledge of business value, and is particularly useful in avoiding resource waste (Li et al., 2017).

Managerial knowledge refers to understandings towards coordinating project elements including team members, materials, tools and policies for the purpose of better management (Kasvi et al., 2003; Lech, 2014). It has been widely recognised that the knowledge required within a project transcend the scope of technical knowledge and includes more generic managerial knowledge, especially for the role of project manager (Edum-Fotwe & McCaffer, 2000).

Experienced expert knowledge is obtained from project experience; it refers to the critical, accumulative experience which has a broader and more generic relevance that can be used in future projects (Li et al., 2017). As Chan (2016) suggests, expertise is a knowledge domain with a strong tacit dimension and is defined during interactions among people in a group context. Each project has its unique tasks and characteristics; however, common problems that take place across different projects (Boh, 2007). Therefore, it is important to share the experience and lessons learnt from previous projects. Furthermore, the sharing and applying of experienced expert knowledge is a process of personal judgement with the aim of applying the general to the particular (Reich et al., 2012). This means that the expert knowledge accumulated with time can be adjusted to different situations and address specific problems. The successful delivery of a project, especially involving participants from multiple organisations, relies on different specialists collectively putting their own expertise to work and sharing professional knowledge (Chan, 2016). In addition, sharing and reusing the experience expert knowledge contribute to organisational innovation, as the previous experience can be a trigger for new ideas in new product and service delivery (Li et al., 2017).

To share the different knowledge domains, it requires skills and efforts from the people involved in the project, particularly those who manage and in charge of the whole construction of the project, i.e. project managers. The following section is focused on the role and function of project manager in project success and in the sharing of project knowledge.

2.3 Role of project managers in knowledge sharing

A project manager is the person who delivers all the components of a project. Project managers undertake three major responsibilities, namely, being responsible to the parent organisation, being responsible to the project and the client, and being responsible to the team members of the project team (Meredith & Mantel, 2011). In practice, although the work of project managers differs between projects, their essential responsibilities are similar, including scoping out and planning the project, deciding on the required resources, getting resources allocated, managing the completion of tasks, and ensuring problem solving (Newton, 2012).

Meredith and Mantel (2011) explained the role of project manager by comparing it to the role of functional manager who leads one of the organisation functional departments such as marketing or finance. The functional manager is usually an expert or specialist in his own working department, knowing significant detail of each operation, analysing difficult tasks and tackling difficulties in the department; however, project managers must know and oversee many different functional areas and departments, each with its own area of speciality (Meredith & Mantel, 2011). The role of project manager is to put together and coordinate these functional areas properly, with the aim of completing project goals (Blomquist, Farashah, & Thomas, 2016). Figure 2.7 describes an example of the roles and knowledge scopes of functional managers and project manager. As shown in the figure, the functional managers are skilful in terms of the knowledge inside their own departments; for instance, the marketing manager knows the agency director, organisational sales, marketing research, competitors and department administrations. The project manager has an overall broader, but less specialised, knowledge about all the departments involved in the project. In organisations, a project manager is usually promoted from a functional

manager, and therefore, they should adapt themselves with the transformation from "technical caterpillar" into "generalist butterfly" (Meredith & Mantel, 2011).

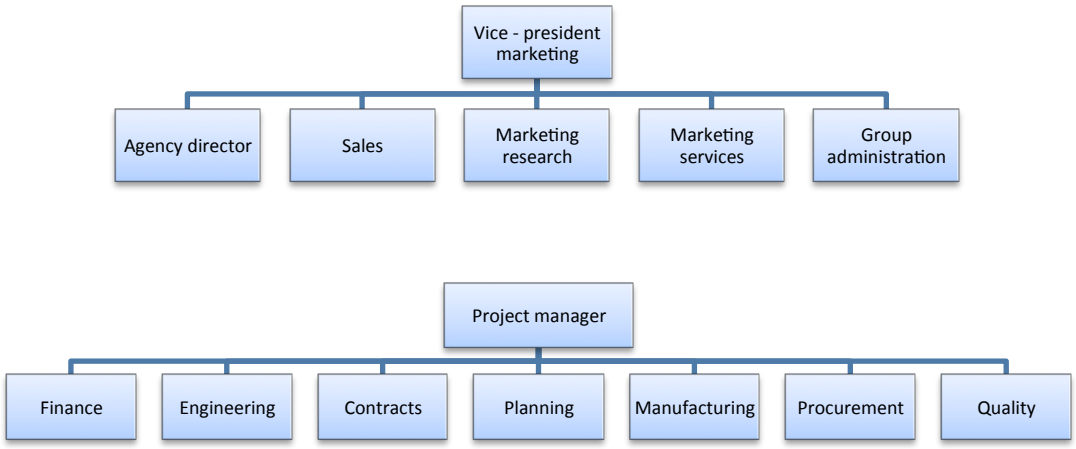


Figure 2.7: Role and knowledge scope of functional manager and project manager (Meredith & Mantel, 2011)

Project management is engaged in the short-term planning and controlling during the process of completing the project, with the aim of on-time delivery, being within budget and meeting expected performance standards (Munns & Bjeirmi, 1996). In practice, the functions of project management include identifying the requirement of work, defining the extent of work, allocating organisational resources, planning the execution of the work, directing the progress of the work and adjusting deviations of the implementation (Munns & Bjeirmi, 1996). The focus of project management therefore is on the life cycle development of the project itself rather than on the long-term benefits of the project.

In comparison, project success generally includes the success of its management; it also involves the long-term project deliveries, such as marketing and financial outcomes, which can be of overall advantage and benefit to the company (Newton, 2012). A successful project not only refers to the completion of current work, but also involves how the project can bring long-term profits to the organisation. In the context of construction projects, for instance, a successful project should be a building that meets the customer's standards or expectations, and satisfaction throughout its life

span. Whereas by the time that the construction of the building is achieved, and its delivery is ready for use, the project management is already considered as being successful.

Project manager plays an essential role in both project management and project success, which can directly influence the organisational performance (Blomquist et al., 2016), especially in handling novel or complex project activities (Newton, 2012). As noted by Crawford (2005) in conducting research in project management, the key to project success is to select the right project manager. The competencies and skills for project managers have a major influence on the business (Crawford, 2005).

Managing and sharing knowledge appears to be one of the most important tasks for project managers (Lech, 2014). This includes project managers themselves identifying knowledge in the initial stage of the project, and creating and sharing knowledge throughout the various project stages (Lech, 2014). Project managers also play the role of integrating, coordinating and managing knowledge from team members within the project. Team members can bring new views that can help experienced project managers to learn (Oluikpe, 2015) and disseminate the knowledge within the project team and apply it in project practice. Besides, success for project managers refers not only to ensuring the project to be successful, but also being able to adapt to different projects (Newton, 2012). This indicates the importance for project managers to obtain and accumulate knowledge from work experience, and apply the knowledge effectively in project practice.

2.4 Factors affecting project knowledge sharing

This section focuses on factors that affect knowledge sharing within the context of projects. Organisations and projects are faced with rapid changing processes due to the dynamics in market environment, customer preference and competitions. A large amount of knowledge is created and gathered in project due to its nature of complexity, uniqueness and resources, as discussed in Section2.2. This requires effective knowledge sharing and rapid application of project members' knowledge into project operation and strategy.

Knowledge sharing is a complex phenomenon; for one factor, depending on its application, it can be either an enabler that improves and encourages knowledge sharing, or a barrier that hinders and discourages knowledge sharing. Riege (2005) conducted a literature review to summarise a wide range of factors that are central to knowledge management and knowledge sharing. The factors fall into three key domains of individual, organisational, and technological. In this section, the discussions also focus on the technological, organisational and individual levels.

2.4.1 Technological factors

The field of knowledge sharing has conventionally been facilitated and influenced by advances in information technology (Oluikpe, 2015; Mirzaee & Ghaffari, 2018). Organisations and projects usually rely on information technology as an important enabler to support and intensify the creation, storage, retrieval, sharing and application of knowledge (Alavi & Leidner, 2001). Despite the fact that greater emphasis is placed today on people-centred methods and that face-to-face communication is widely recognised an effective approach, digital tools such as software and email communication are commonly used to share knowledge due to time and location constraints (Parboteeah, Jackson, & Wilkinson, 2016).

Information communication technologies enable knowledge sharing through various methods, including email communication (Jackson & Tedmori, 2004), codification of knowledge in computerised databases (Adenfelt & Lagerström, 2006), and social websites (Ellison, Gibbs, & Weber, 2015). Many project knowledge sharing practices are reflected and assisted by these technologies. For example, Oluikpe (2015) suggested that project learning relies on both knowledge replication and codification. Schindler and Eppler (2003) adopted a process-based method to gather project knowledge in an organisational database and enable systematic project knowledge sharing. They argue that one of the project knowledge sharing problems is that knowledge and experiences are gathered in various projects rather than systematically integrated into the central database.

Johansson, Moehler, and Vahidi (2013) investigated the project knowledge sharing methods in a Swedish project-based company. They discovered that a very common

way for knowledge contributors to express and share knowledge with other projects is by employing a codification strategy; and knowledge receiver adopts a personalisation strategy to understand and use the shared knowledge in their own project. The personalisation strategy here is in accordance with the internationalisation in Nonaka's knowledge creation SECI model (discussed in Section 2.1.3), as the internationalisation is the process of the individual understanding the new knowledge and storing it in their own mind. Therefore, codification and computer systems account for a large proportion in organisational project knowledge sharing practices.

Despite the widely adopted information technologies in projects and the contributions of them in sharing knowledge, they are confronted with challenges and criticisms. Researchers constantly argue that there is a large amount of tacit knowledge loss when people rely on information systems or digital tools to share knowledge (Panahi, Watson, & Partridge, 2013). The sharing or retention of knowledge does not mean that it is of necessity to codify all individual employees' knowledge into computer system with the hope that project knowledge could be shared by other members, or be retained in other projects (Boh, 2007). In practice, it is always the relevant project documentation such as a summary, a technical report, a feasibility study or a description of project that has been codified due to the aim of merely meeting minimal documentation standards, while the more useful and complicated recordings such as failure reasons and the process of building solutions are often omitted (Panahi et al., 2013). Particularly, this research is conducted in the construction industry where multiple organisations are always involved in a single project, it is difficult to rely on technology methods to record or reuse the knowledge accumulated from other projects. The fact that these three groups are usually from different organisations and that they separate again after project completion, makes knowledge sharing more difficult if only some basic documents are recorded in technological systems.

Furthermore, information technologies usually facilitate knowledge sharing regarding a particular event or problem, whilst sharing knowledge should be a daily and routine activity for the long-term benefits of business (Parboteeah et al., 2016). It is the individuals in the organisation and project that hold knowledge. Knowledge is always bound to people involved in project practices or problem solving processes, which is

often not a part of a project's computerised documentation or is rarely transferred to other people through computer systems. It is difficult to rely on technology to create an environment where people both want to share what they know and make use of what others know, especially for the sharing of tacit knowledge (Panahi et al., 2013; Riege, 2005). In projects, team members return to their line functions carrying their knowledge with them after project completion, and this knowledge is then only accessible through informal networks rather than technological systems (Schindler & Eppler, 2003).

Another technological challenge is that without understanding the relationship intricacies between people and the roles people play, the technology itself cannot be well implemented or practiced in knowledge sharing (Casimir, Ngee Keith Ng, & Liou Paul Cheng, 2012). There have been many examples of information systems and social web tools being abandoned due to neglects of actual user requirements (Hendriks, 1999; Riege, 2005; Serenko, Bontis, & Hardie, 2007). Technology is one area of where project knowledge exists and is shared; although most of project members see information technology as a useful tool, real project practices are considered as the main area where new project knowledge is created and shared (Mueller, 2015). In addition, there exists mismatch between computer systems and operation users. The employees sometimes have unrealistic expectations as to what technology can do and the integrated system does not meet its user requirements (Serenko et al., 2007). When the expectations are not met, the members tend to be reluctant to use the technology, which can negatively affect sharing knowledge in a timely manner.

In fact, when managers were asked about the major challenges they faced in facilitating knowledge sharing, most of their answers were people-related such as lack of communication and lack of understanding of knowledge sharing benefits rather than technologies (A. Cabrera, Collins, & Salgado, 2006). The sharing of tacit knowledge is still considered as people-centred issue rather than technology (Panahi et al., 2013). When the focus of knowledge sharing is on 'tech centred tools or techniques' rather than 'people centred tools and techniques', knowledge sharing activities can be discouraged (Parboteeah et al., 2016).

To tackle these problems, it requires both organisational efforts and more importantly, high skills from the people involved in the project, particularly those who manage and are in charge of the whole construction of the project, i.e. project managers. The following two sub-sections discuss the factors from the organisational and individual levels.

2.4.2 Organisational factors

2.4.2.1 Organisational culture and trust

In contrast to technologies, the 'soft' factors such as organisational culture and trust proved to be more powerful in influencing knowledge sharing practice, especially at the project level (Wiewiora et al., 2014). For example, Adenfelt and Lagerström (2006) investigated the different enablers in project knowledge sharing, including culture, structure and information technologies; the results suggested that culture plays a critical role in project knowledge sharing, and that culture allows a higher degree and usage of interpersonal communication. This is because of the facts that knowledge sharing is difficult to be controlled or forced, and that individual behaviours are affected by organisational environment (Lilleoere & Hansen, 2011).

Organisational culture refers to the shared assumptions and values within an organisation; it is gained and accumulated when the organisation copes with its environment and solving problems in terms of both external adaption and internal integration (Alawi, Marzooqi, & Mohammed, 2007). It a wide concept and different dimensions (Goh, 2002). To build a culture of encouraging knowledge sharing, different aspects need to be considered. Values and practices can shape the organisational environment within which members establish rules about how they interact and share knowledge (Wiewiora et al., 2014). Bhagat, Kedia, Harveston, and Triandis (2002) suggest that organisations with individualist culture tend to share explicit knowledge in a better manner, whilst those with collective culture are better at sharing tacit knowledge. The organisational culture that enables knowledge sharing is that individuals are highly supported and trusting of others and of the organisation, an open climate with free-flowing information, and appreciation of sharing and tolerance of well-reasoned failure (Bock, Zmud, Kim, & Lee, 2005). McDermott and O'dell (2001)

distinguished the visible and invisible dimensions of culture: the visible dimensions can be reflected by enterprise espoused values, missions, structure and spaces; the invisible ones, at a deeper level, guide what people do and how they interact with each other in an unspoken way. Additionally, the issues of individual interpretations and language also need to be considered, especially for multinational corporations (Jackson, Parboteeah, & Morgan, 2012).

Organisational culture is closely related to trust, especially interpersonal trust within organisations and projects; furthermore, there exist strong interactions between organisational culture, trust, and knowledge sharing (Wiewiora et al., 2014). Trust is viewed as an individual or a group's expectancy in the reliability of some commitment or action from other individuals or groups (Alawi et al., 2007). Based on the social capital theory, strong trust among social actors increases the good will among employees, and has a positive influence in mutual understanding and sharing (Choi et al., 2008). Similarly, Lilleoere and Hansen (2011) suggest that informal networks are one of the key vehicles for knowledge sharing; trust among individuals is closely related to this type of informal networks.

Efficient supervisory and peer support within organisations and project teams can contribute to the trust in the project and the organisation. Leadership and support from managers contribute to employee's learning experience through providing them the needed knowledge and encouraging their knowledge sharing behaviours (Fullwood & Rowley, 2017). Studies in organisational behaviours have long established the relationship between normative beliefs and intentions to behave in a certain way. People tend to behave in certain way if they believe that some important relevant individuals are likely to encourage and appreciate such behaviour(Cabrera et al., 2006). Organisational and team members are more inclined to share their knowledge with others to the extent that approval from peers and supervisors is expected (Cabrera et al., 2006). Better peer support assists in improving organisational cooperation and communication, which positively affects group sharing performance.

2.4.2.2 Organisational structure and job design

Many researchers have explored the relationships between organisational structure and knowledge sharing practices. There is no established particular mode of structure that promote knowledge sharing, however, an open and flexible organisational structure always encourages members to share their knowledge (Riege, 2005). Decentralised structure inside an organisation enables knowledge sharing behaviours more effectively than bureaucratic structures (Fullwood & Rowley, 2017). In terms of teams, studies indicate that team with a reasonable size, preferably a smaller or medium size, tend to benefit more from knowledge sharing; communications tend to be more centralised in these teams (Parboteeah et al., 2016).

The structure of an organisation has an impact on its job design, which can also affect the knowledge sharing behaviour. Job design is a commonly discussed topic in human resource management, and its importance derives from the influence it has on employees' motivations (Parker, 2014). Job design refers to deciding actual job structure, identifying tasks and responsibilities and allocating them to relevant employees in a method which enables the organisation to harvest benefits from specialization (Foss et al., 2009). The more autonomy a job allows, the more responsible jobholders feel for their performances and work outcomes (Cabrera et al., 2006). When the jobholders have more freedom and authorities to choose when, where and how to complete the work, they tend to be more dedicated to the tasks and more care about results and achievements. For this reason, job design affects employee's behaviour in sharing their knowledge, as the idea that knowledge sharing positively affects group performance and creates competitive advantages has been widely accepted.

Cabrera et al. (2006) suggest two main reasons why job design and autonomy affect employees' participation in knowledge sharing. First, the inclination of a person to share knowledge with his co-workers relates to the responsibility degree that the person feels for his job. Employees with higher level of job responsibility would search for better ways to do their work, and to achieve that, one efficient method is to share knowledge and experience with other employees. Another reason is that job autonomy exerts fewer frameworks on employee in terms of how the work must be done, which

gives the autonomous employee more space to search for creative ways to express ideas, receive knowledge from others and perform better. Therefore, job design is an important factor for organisations that aimed at receiving benefits from employee's knowledge sharing activities. In addition, such sharing would be particularly vital when there exist risks that highly knowledgeable employees might leave the firm or retaining such talents and knowledge involves high costs (Foss et al., 2009).

2.4.2.3 Knowledge sharing mechanism

Organisations adopt different mechanisms for employees to share knowledge (Wiewiora et al., 2014). The mechanism refers to formal and informal ways for sharing, integrating, interpreting and applying know-what, know-how and know-why embodied in individuals and groups that will help in the project performance (Boh, 2007).

Studies in project knowledge sharing illustrate that team members tend to seek knowledge from their peers and colleagues rather than technologies (Wiewiora et al., 2014). Knowledge is very difficult to exploit, especially for project knowledge. Even when the knowledge be clearly explained and articulated, it still requires a shared system of meaning for project members to understand, accept and deploy the knowledge (Bresnen et al., 2003). Prencipe and Tell (2001) developed the first organisational learning mechanism based on project firms. They viewed project-based firm as a population of projects where project traits and knowledge could be transferred and shared via different mechanisms from one project to another. Boh (2007) discussed and developed four mechanisms – personalization, codification, individualization and institutionalization – for sharing knowledge in project-based companies with the emphasis on distributing project knowledge. He also suggested that the selection of different mechanisms should depend on organisational size, geographical dispersion and the job nature. Proper size and structure of the company itself also enables the usage of certain mechanisms that encourage cross-regional and cross-project knowledge sharing (Bresnen et al., 2003). The centralization and formalization structures of the organisation have considerable impacts on coordination within and cross project team corporations and on knowledge creation and sharing (Adenfelt & Lagerström, 2006).

However, it is challenging for project-based organisations to develop a regular knowledge sharing mechanism because of the project characters. In functionally-based firms, function departments act as knowledge silos that store the accumulated organisational knowledge, while the pure project-based companies lack the organisational mechanisms for the knowledge acquired and accumulated from one project to be shared and used in other projects (Prencipe & Tell, 2001). As each project has its own unique objectives and processes, the mechanism needs to generalize the common aspects and natures of the projects, which is difficult to practice or realize. Lindner and Wald (2011) also suggest that projects lack "natural" mechanism of learning and sharing in the contrast of organisational daily operations; as a consequence, the knowledge from individuals is rarely shared even during the processes a project.

The knowledge sharing mechanism also affects knowledge sharing among peers working on different projects inside one organisation. Usually in project based companies, relationships are cross-functional and people work together across different departments. This encourages knowledge sharing across sub-boundaries yet at the same time isolate people from same department peers (Ruuska & Vartiainen, 2005). Lacking in proper knowledge sharing mechanism increases the isolation, as it is more difficult for people to share knowledge voluntarily than having regular organisational rules to obey. Ruuska and Vartiainen (2005) claimed the second challenge of project knowledge sharing is how to enhance the communications and knowledge sharing among peers from the same department while working in dispersed projects. And the challenge gets more serious towards the shortage of knowledge sharing mechanism when it comes to the geographically dispersed projects and intercultural project teams (Boh, 2007). This leads to the organisational knowledge fragmentation and loss of organisational learning. In addition, the shortage of knowledge sharing mechanism also reflects on the way of human resource division. In some industries where the organisations take a complicated way in their labour division between professionals and other project members, for example the construction industry, which makes the attempts of sharing knowledge, innovation and

learning more difficult (Bresnen et al., 2003). This leads to the organisational knowledge fragmentation and loss of organisational learning.

Community of practice is a commonly adopted approach in sharing knowledge inside organisations and between different projects. It refers to a unifying unit for analysing, diagnosing and understanding knowledge in organisations (Brown & Duguid, 2001). Before indicating the impacts of communities of practice on project knowledge sharing, it is important to distinguish between communities of practice and projects. Communities of practice are organized around circumscribed sets of activities that reflect both the pursuit of enterprises and the attendant social relations (Wenger, 1998). They develop own rules and routines to share and store assumptions, knowledge and related contexts (Garrety, Robertson, & Badham, 2004). The most obvious difference between communities of practice and projects is that project has defined dates of starting and completing. People working on a project may belong to several communities of practice; to what extent that the communities are involved in a project can vary (Garrety et al., 2004).

Practices assist in revealing the “embedding” conditions and tacit valuable information of the organisation (Brown & Duguid, 2001), and therefore, communities of practice are believed to be useful for revealing and examining organisational and project knowledge. It is viewed as a brokering enabler that members construct both shared identities and the social context which helps the identities to be shared (Ruuska & Vartiainen, 2005).They are the privileged places for tight and effective insights into problem identification, learning and knowledge solution. As Von Hippel (1998) suggested, useful information and knowledge is often best developed not by specialists analysing a problem or reviewing the past experiences, but by those who directly benefit in solving the problem and in need of finding out a solution. The “who”, contended by Brown and Duguid (2001), are likely to be the community members

In organisational and project practice, there has always been a need for the balance between differentiation that teams and experts work separately and integration that project group meet together to share knowledge (Garrety et al., 2004). The form of communities of practice can help project managers to achieve this balance because it

connects communications by aligning people in different areas and interests whilst guaranteeing their individual working time (Nidumolu, Subramani, & Aldrich, 2001). It is particularly useful when cross-functional teams are the basic structures of the organisation, as the teams and projects benefit from integrating and communicating experts from diverse sources (Ruuska & Vartiainen, 2005).

2.4.2.4 Reward and recognition system

Reward and recognition system is considered as an external factor that motivates knowledge sharing (Wang & Hou, 2015). It includes both 'hard' reward representing visible interests such as financial incentives and goals, and 'soft' reward and recognition such as reputation. The reward and recognition system is related to motivations and has been identified as the important trigger for general knowledge sharing behaviour (Lin, 2007).

Knowledge and interests are inter-related; interests can affect knowledge sharing in terms of how much an individual is willing to share and to learn the knowledge from others (Easterby-Smith & Lyles, 2011). The rewards can range from monetary benefits and bonus to dinner gifts to public certification (Bartol & Srivastava, 2002). Proper reward system not only highlights the things that the company feels important, but also demonstrates that the time and dedication that employees spend on knowledge sharing "counts" in their performance (McDermott & O'dell, 2001).

However, some researchers argue that contrary to common belief, economic reward actually has no significant effect on employee's attitude toward knowledge sharing (Bock et al., 2005; Zhang & Ng, 2012). A rewarding system can only be effective at the initial stage of knowledge management and sharing, as rewards only acts as a trigger for knowledge sharing rather than a sustainable force to force or encourage individual attitudes (Zhang & Ng, 2012). Jackson et al. (2012)'s study also suggests most organisational employees agree on that there should be no rewards regarding knowledge sharing; the culture and encouragement inside the organisation is more important. The organisational incentive strategies such as pay-for-performance compensation structures can even discourage knowledge sharing, if the knowledge

holders believe such sharing activities hinder their personal efforts to distinguish themselves from co-workers (Bock et al., 2005).

One explanation is that individual sharing of tacit knowledge can be hardly observed and measured directly with a team, and it is difficult to attribute the output to a particular person (Osterloh & Frey, 2000). In the construction industry, for instance, if project team performance is improved through team members effectively sharing of ideas and cooperating with each other, rewards can be awarded to the whole team instead of the knowledge sender (Zhang & Ng, 2012). Sometimes it is even difficult to identify who is the knowledge sender. As a consequence, economic rewards which might be an indirect enabler for knowledge sharing in other industries but not the main concern when team members share knowledge in construction projects.

2.4.2.5 Temporariness and customisation of projects

An unavoidable conflict between the opposed nature of project and knowledge sharing is a critical challenge for sharing project knowledge (Lindner & Wald, 2011). Projects usually have a relatively short-term orientation with dedication in immediate deliverables, as they are aimed at completing project goals before deadlines. However, knowledge management and knowledge sharing are long-term activities, always with a time-lag between the initial investment in capital, time and human resources and the final investment returns (Lindner & Wald, 2011). This conflict can affect the knowledge sharing practice in projects.

As the result of the temporary and customised nature, one of the main challenges is the difficulty of sharing the common knowledge among different projects. There has always been a misconception to assume that it is no need to learn or share knowledge across projects since there are little commonalities between different projects (Boh, 2007). Ruuska and Vartiainen (2005) generalized the challenges of project knowledge sharing into two questions and the first one is how to share the accumulated knowledge in one project with others. This problem only occurs in project context (as organisational daily operations are repetitive instead of temporary), and indeed each project is unique and customized compared to the regular operations.

Project teams are groups of people drawn from within or outside the organisation to undertake specific projects. The teams are temporary as by the time when the project is finished, the team automatically disbands and the members are reabsorbed into the organisation and new projects (Keegan & Turner, 2001). Projects also have their unique contents and are distinguished from one another. As a consequence, discontinuities in information flows in terms of personnel, contexts and materials are created, which makes it difficult for organisations to develop or follow a steady state routine to maximizes the value of knowledge and difficult to capture the learning and experience from one project to the next (Bresnen et al., 2003). The temporary and customized characters of project also makes it difficult to build up organisational knowledge capacities that function as a knowledge base supporting different project processes (Boh, 2007). In some particular types of project settings – for example the construction industry where this research is conducted – such discontinuities and lacking knowledge capacities are even counted up because the construction project team is fragmentized into at least three different disciplines with professions in different areas. Each discipline has its own knowledge foundations, making it more difficult and less efficient to codify or share knowledge, which will be further discussed in chapter three.

Moreover, the discontinuous team compositions and different working content in each project lead to a fragmentation and disintegration of project knowledge (Lindner & Wald, 2011). People involved in one project sometimes are not only organisationally but also geographically dispersed, with diverse backgrounds and different languages. Due to the temporal limitation of projects, the people involved and the lessons learned are dispersed when the project ends (Kasvi et al., 2003). If there are sub-contractors or consultants who acquire large amount of tacit project knowledge involved in the project, the relationship between those people and the organisation either ends with the completion of the current project or being rehired for other projects of the company (Keegan & Turner, 2001). With the ending of the relationship, the project knowledge is also dispersed into different involvers. This dispersion leads to the organisational knowledge fragmentation and loss of organisational learning, which makes it difficult to share project knowledge.

Another impact is that employees are not motivated to explore, learn and share the failures from the past, as each project differs from others (Cooper et al., 2002). Employees tend to get on with next project immediately after completing one. However, the common problems and knowledge among different projects are always neglected. In addition, because of the time pressure, project teams tend to giver lower priority to the activities not directly contributing to the project deliverables (Johansson et al., 2013). Therefore, special efforts need to be spared on gleaning and improving upon transferable lessons across projects (Boh, 2007).

2.4.3 Individual knowledge sharing factors

Understanding factors that impact individual knowledge sharing behaviour is critical, as knowledge sharing, to a large extent, is dependent on individual cognitions (Hu, 2010). As the knowledge carriers, sharers and receivers, individuals form the core of knowledge sharing and take the responsibility of generating and sharing knowledge (Baker & Yusof, 2016). To improve knowledge sharing efficiency, the basic and first step is to encourage individuals to share knowledge with their colleagues (Lin, 2007). Zhang and Ng (2012) also suggest that the key to improve knowledge sharing in project teams is about individuals' attitude towards knowledge sharing.

2.4.3.1 Personal characteristics

Staff personalities and characteristics are related to important organisational outcomes such as job performance, sales and leadership efficiency (Cabrera et al., 2006). One of the most considered theories for personal characteristics, the five factor model (FFM) of personality, indicates five personality dimensions affecting individual performance: emotional stability (versus neuroticism); extroversion (versus introversion); openness to experience (versus closeness to experience); agreeableness (versus rudeness); and conscientiousness (versus non dependability) (Costa & Mccrae, 1990). Cabrera et al. (2006) suggest that three of these dimensions would be related to knowledge sharing behaviours: agreeableness, conscientiousness and openness to experience. Agreeable individuals are those tend to be cooperative and supportive in work performance and therefore, they are more inclined to respond to the knowledge requests from others and provide own ideas as knowledge sharing resources. Conscientiousness staffs, with strong sense of responsibilities, act as both knowledge seekers and receivers in order

to complete their tasks, which indirectly improves the sharing activities in organisations. Openness to experience relates to characters such as curiosity and sensitivity, and those individuals with open attitudes towards experience tend to seek knowledge from others and more active in knowledge seeking and sharing processes (Cabrera et al., 2006). These three personality characters help to promote the organisational knowledge seeking and receiving behaviours, which in consequence, makes it easier to share organisational knowledge.

Self-efficacy is considered as another crucial factor in individual knowledge sharing behaviour (Baker & Yusof, 2016), especially in understanding why people choose to pursue some particular activities and why people share knowledge in certain context while not in others (Hu, 2010). Self-efficacy refers to the judgement that people perceive themselves in terms of their capability in executing certain performance (Bandura, 1994). It has a direct influence on individual's inclination in engaging with a specific course of action, as the perceptions of self-efficacy are formed via a judgment process that people undertake when deciding whether they can perform a task (Bandura, 1994). Therefore, people with higher self-efficacy tend to share knowledge, especially complex knowledge and past experience, more actively (Okyere-Kwakye & Nor, 2011).

Self-efficacy can be considered as a type of intrinsic motivation in knowledge sharing. Individuals gain satisfaction and pleasure derived from their experience and the impact motivational factors such as self-efficiency and development enhance the sharing of knowledge (Foss et al., 2009). Employees find the knowledge sharing activities interesting and enjoyable, and that they are willing to involve in knowledge sharing practices with aims such as improving work performance (Foss et al., 2009). They also improve their confidence towards their ability of providing useful knowledge to the organisation and the project they work on. Furthermore, employees, especially participating in projects, tend to have higher self-efficacy when they expect reciprocal knowledge sharing from their counterparts and when they share something directly from their past experience (Endres, Endres, Chowdhury, & Alam, 2007).

2.4.3.2 Job security and time

One of the main psychological reasons to explain why employees tend to not share their work-related know-how with colleagues and instead choose to hoard knowledge is lack of safety or security (Bendoly, 2013). Psychological safety refers to employees' sense of being able to express and employ themselves without fear of its negative impacts on self-image or career (Edmondson, 1999). Perceived fears or risks include appearing foolish, political isolation and the possibility the individual might be negatively ostracized (Bendoly, 2013). Employees seeking for knowledge might be afraid of showing their weakness or incapability in performing tasks, while the people with unique ideas may also be in the fear of being isolated if their opinions differ substantially from the majority of the group and organisation.

In addition, in some individuals' way of thinking, share knowledge means weakening their own corporate position, power or status in the organisation (Riege, 2005). Bock et al. (2005) suggest that hoarding knowledge and being reserved about the knowledge offered by others are natural human tendencies. In the organisational context, hiding personal knowledge instead of sharing comes from the natural protection of the person self. The lacking in job security also relates to the barrier of manager's low tolerance. Lacking of tolerance for mistakes and misunderstandings in managerial operations would limit employees from sharing knowledge, as they might be in fear of making mistakes or even losing their jobs (Serenko et al., 2007).

Another common problem with knowledge sharing is that individuals do not find convincing reasons to share their knowledge and therefore do not spend time on this (Jeung, Yoon, & Choi, 2017). Insufficient time for sharing activities or practices is another barrier, which is usually reflected in the lack of contact time and interaction between knowledge source and recipients. The dominance of shared knowledge, especially tacit knowledge such as know-how and experience requires hands-on learning, observation, dialogue and interactive problem solving (Serenko et al., 2007). These procedures usually take long time to go through and therefore, abundant or at least adequate time is necessary. Not only does sharing knowledge cost individual time and efforts, but doing such activities in organisational settings also generates the classic public good dilemma: individual contribution for the good of the organisation

can be used by others regardless whether or not they contribute in return or not (Bock et al., 2005). This problem can be intensified when expertise is highly valued in an organisation while helping or monitoring others is not (Bock et al., 2005). Moreover, the lack of time to identify colleagues in need of particular knowledge also limits effective knowledge sharing. One of the explanations for employees or organisations lacking time is their unawareness of valuable knowledge (Odell & Grayson, 1997). Improper extrinsic or intrinsic reward system in the organisation which is unable to compensate the knowledge sender for the cost of sharing knowledge also makes the barrier difficult to solve.

2.4.3.3 Individual Skills and Responsibilities

Individuals who are expected to share knowledge are always considered as organisational experts and knowledge owners (Bock et al., 2005). Knowledge is always embedded in individuals, and their skills in sharing the knowledge have a significant impact on the knowledge sharing efficiency. As suggested by Ardichvili (2008), knowledge owners with a high level of skills and willingness significantly contributes to the organisational knowledge sharing outcome through their participation in knowledge sharing.

Knowledge in project-based context tends to be embodied in members of the network of professions (Bresnen et al., 2003). The valuable and useful project knowledge tends to remain in a tacit way inside individuals' minds. Therefore, the individual skills and responsibilities of the project team members become an important factor influencing the outcome of project knowledge sharing. Liebowitz and Megbolugbe (2003) identified different factors that influence knowledge sharing and the reuse of knowledge in project environment. They suggest that three individual skills are essential, including the ability to quickly assess credibility and usability of project knowledge, the ability to quickly assess degree of the current knowledge to fit problem, and the ability to quickly assess implement-ability of project knowledge. These individual skills enable the project team members to share and to understand the knowledge that they receive.

Kerzner (2013) suggests that the major factor for the successful project management implementation is that the project manager and team become “the focal point of integrative responsibility”. The sense of responsibility in terms of sharing project knowledge is critical for both knowledge sharing and project success. In addition, the knowledge sharing mechanisms such as reward system and individual value system sometimes can encourage the development of individual skills and increase the sense of responsibilities (Kerzner, 2013).

The individual skill in terms of project experiences and performance gap is another important factor affecting project knowledge sharing. People with different levels of experiences, knowledge and performance find it difficult for them to understand and share their experience and knowledge, especially when large specific technical knowledge is involved (Riege, 2005). The communication and understanding problems are enlarged with the experience and performance gap. However, sometimes the existence of one or several gaps may create motivations for project team members to consider searching for existing knowledge, which encourages the informal knowledge sharing behaviour (Liebowitz & Megbolugbe, 2003).

For the role of project managers, their individual skills that have an influence on project knowledge sharing extend towards a broader range. For example, lack of leadership and managerial direction from project managers discourages knowledge sharing behaviours of employees (Serenko et al., 2007); not able to allocate human resources and project resources such as finance and materials can also be against effective knowledge sharing (Fisher, 2011).

Considering the various factors that impact knowledge sharing, it is important to identify individual skills, especially when consider the aim of using the factors that contribute to knowledge sharing and avoiding relevant barriers. The next section is focused on the concept of skill and relating the skill to the context of knowledge management and project management.

2.5 Skill and knowledge sharing

2.5.1 Definition of skill

Skill is commonly recognised as a "*particular ability or type of ability to do something well*" (Attewell, 1990; Li et al., 2017). When reflected in different areas of studies, the definitions and perspectives on skill can be different and understandings towards it vary from one to another. In psychological and human capital fields, skill is considered as an independent variable connected to the properties of workers instead of the jobs (Vallas, 1990). It is accepted to be an attribute without being affected by external factors such as working environment and practice. In sociological studies, however, the perspectives are often reversed. Researchers tend to think that skill has a dependent nature, attached to a particular context such as occupation, organisation and social situation (Vallas, 1990); discussions on the concept of skill tend to focus on its applicable professional dimensions and the knowledge embedded in, or associated with, the techniques during work processes (Rigby & Sanchis, 2006).

This implies the recognition that numerous skills exist, and the demands for them distinguish according to the requirements of a particular occupation and industry (Li et al., 2017). It also suggests a common characteristic of skill; skill is closely related to its dependent context and can be developed through practice. It is a concept that is highly dependent on experience and requires further clarification according to the actual context (Krogh & Roos, 1995); it extends beyond merely task-focused issues and relates to the value and success of the business. As this study focuses on the skills for a group of people with a particular occupation (i.e. project manager) within a particular industry (i.e. the construction industry), to consider skill as an object attached to a particular context and profession seems to be more appropriate for this research.

Skill is also considered as being developed and achieved from practice, rather than given. In organisational studies, skill is often related to staffs' capability of negotiating the new, more changeable and communication-rich world of work (Martin & Healy, 2006); it is developed from ongoing engagement in social practice (Orlikowski, 2002). Similarly, Odusami (2002) also suggested that skill is an ability that can be developed and manifested in performance. The underlying consideration in this research is

consistent with the argument that skill is achieved, developed and can be applied in practice, i.e. the practice of knowledge sharing with project participants.

The notion of skill is closely linked to the notion of competency. In some studies, skill and competency are considered as similar and replicable with each other (Shi, Ye, Lu, & Hu, 2014). In this prospect, the term skill is used as equivalence to competency. However, there is an argument that competency means more than skill. For example, Dogbegah, Owusu-Manu, and Omoteso (2011) suggest that competency in project management includes the knowledge, skills, abilities and personal traits. Competency includes both the "knowledge" and the "task", i.e. competency is knowledge-specific, as it needs to use sufficient knowledge, and is task-specific because it always needs a particular task within a certain context to apply (Von Krogh & Roos, 1995).

Competency is also defined as the integration of knowledge, skills and attitudes (Baartman & Brujin, 2011). In this perspective, knowledge, skills and attitudes are the important resources in organisation development and product improvement (Lopez-Cabrales et al., 2009). The notion of knowledge, skills and attitudes are considered together in different research areas including education (e.g. Henderson, Happell & Martin, 2007), management in organisation (Lopez-Cabrales, Perez-Luno & Cabrera, 2009), and knowledge management (Chen & Huang, 2009). The underlying assumption is that competency is a broader term including the knowledge about an area, the skills of conducting work in this area, and the attitudes involved in conducting the work. This research is focused on skills that contribute to knowledge sharing practices, and the identification of different knowledge domains serves as a first step to understand the context within which knowledge sharing takes place. Furthermore, this research is specifically focusing on skills, not on competency which contains a broader context. In this research, the term skill is considered as an important and specific dimension of competency. Therefore, the notion of attitude is not considered as a need for further exploration or investigation.

2.5.2 Skill in human resources sector

Human resource plays an important role in developing organisational competitive advantage and adding value to the business. In this research sector, the notion of skill is

considered to be the demonstrated knowledge and abilities in allocating resources and ensuring delivery of ideas and programs, which help the business to be better operated (Ulrich, Brockbank, Yeung, & Lake, 1995). Development and utilisation of human resources skills can contribute to the sustained competitive advantages of organisations.

Lado and Wilson (1994) reviewed the literature on human resource from a competency-based perspective. They suggest that the human resource competencies have the strong characteristics of being firm specific, producing complex social relationships, embedded in organisational history and culture, and generating tacit organisational knowledge. Based on these, they categorised competencies in organisations into managerial competencies, input-based competencies, transformational competencies, and out-put based competencies. Managerial competencies refer to the organisational leaders being capable to articulate a strategic vision, communicating the vision throughout the organisation and enabling members to realise the vision (Lado & Wilson, 1994). These types of competencies assist at a high level in achieving organisational goals. Input-based competencies involve the organisational components of physical resources, human resources, and knowledge and skills that facilitate transformational processes of a firm in order to deliver customer-valued products (Lado & Wilson, 1994). These competencies both influence and are influenced by strategic vision, and encompass capabilities in exploiting imperfections in the industries, creating internal labour markets and investing in firm-specific human capital (Lado & Wilson, 1994). They serve in maximising organisational resources at a lower level compared to managerial competencies. Transformational competencies emphasise harnessing innovation and entrepreneurship, promoting organisational culture, and fostering relevant learning. Out-put competencies are focused on external and invisible assets such as corporate reputation, service quality and customer loyalty (Lado & Wilson, 1994).

2.5.3 Skill in library and information science sector

Discussions on skills in the library and information research emphasise the importance of both role-specific professional skills and generic skills which can be applied across different disciplines (Orme, 2008). With the rise of information technologies,

researchers in this area tend to shift the definition and consideration of skill beyond traditional boundaries towards a digital information era (Nonthacumjane, 2011). Among these, technical and IT skills are more often raised than previously.

Feret and Marcinek (1999) categorised five main skills for the role of academic librarians, namely communication skills, IT skills, managerial skills, commitment skills and subject knowledge skills. Goulding, Bromham, Hannabuss, and Cramer (1999) conducted content analysis on a variety of job advertisements, in order to find a list of personal skills that are essential for professions working in the library and information science area; they identified four critical skills including communication skills, flexibility, capability of working under pressure, and ability to serve a range of users. Orme (2008) classified the skills into three levels of generic, personal and professional, indicating that generic skills are mostly in demand with professional skills and personal skills in second and third places respectively.

Nonthacumjane (2011) reviewed the current literature on key skills and competencies for library professionals, and categorised the skills into personal skills, generic skills and discipline-specific knowledge skills. Personal skills refer to appropriate attitudes, values and personal traits including characteristics such as being analytical, creative, flexible, reflective, responsive and self-motivated (Nonthacumjane, 2011). This set of skills is related to the person in conducting the professional work. Generic skills are applicable across a range of disciplines including communication, critical thinking, information literacy, ethics and social responsibility, problem solving, teamwork and leadership. The skill of discipline-specific knowledge is regarded as the knowledge gained through individual educational experience (Nonthacumjane, 2011).

2.5.4 Skill in knowledge management and sharing sector

The current literature tends to categorise different skills that are relevant to knowledge management, but only a few studies attempt to discuss the definition of skill in this particular sector. Skill in knowledge management in general is related to the degree to which the knowledge resources are generated, shared and utilised (Martinez-Conesa, Soto-Acosta, & Carayannis, 2017). Skill in knowledge sharing can be referred to the capability to translate knowledge, especially tacit knowledge, into action (Odusami,

2002). With consideration of the project management context, the skill for knowledge management and sharing within a project domain is defined as the capability of integrating the obtained knowledge from previous projects through individual experiences or trainings, and then being able to apply the knowledge to relevant projects (Lin, Wang, & Tserng, 2006). In accordance with the generic definitions above and their underlying assumptions, skills (contributing to knowledge sharing practice for project managers) in this study refers to being able to effectively externalise individual knowledge, including previous experience integration, complex knowledge explanation and efficient sharing strategy identification, and share this efficiently with other project members (Li et al., 2017).

Through investigations on knowledge-related activities, Ali (2001) pointed out that generating new knowledge and administrating knowledge are the two ambitions perused by researchers and practitioners. To generate new knowledge, creating knowledge-related activities and having the relevant skills are required. This is because generating new knowledge is closely linked to innovation and commonly associated with creative behaviours; the skill of making activities concentrates on creating new ideas and new techniques (Ali, 2001), In contrast, in order to administrate – document, manage, share, control – knowledge, using activities and having the relevant skills are essential (Ali, 2001) as the activities can be considered as practice where the knowledge can be managed (Oluikpe, 2015).

In the context of organisation or project, there is a wide recognition that soft skills and social interactions are more important than the role of technical knowledge or skills in the process of knowledge sharing (Kucharska & Kowalczyk, 2016). The study from Qiu and Lui (2014) also suggests that soft skills, especially the capability in forming communication channels for face-to-face social interaction, can increase the sharing and transferring of tacit knowledge; it positively affects the growth and outcome of knowledge flows between the sender and receiver, and breaks the boundaries that exist between two actors. In addition, it also helps to form opportunities for social construction of knowledge in a learning setting, which grants the social interaction as a factor to stimulate intra-organisational knowledge flow and sharing (Qiu & Lui, 2014).

To further relate the skills relevant to knowledge sharing in the current literature, three types of skills are summarised in the following paragraphs.

Identify Suitable Knowledge to Share

The ability of identifying knowledge resources, as the fundamental content of knowledge sharing activities is an important skill for managers. Choi et al. (2008) discussed knowledge sharing and knowledge management in terms of both knowledge focus and knowledge source. They classified the dimension of knowledge source into internal and external oriented and highlighted that the organisation achieves more benefits by adopting both internal and external knowledge sources than by choosing one in favour of the other. The internal-oriented knowledge is a source that is generated and shared inside the firm while the external-oriented knowledge is brought from the outside and acquired by the knowledge-seeking firm.

Skyrme and Amidon (1997) explored from the perspective of organisational learning and proposed five dimensions for organisational learning and discovering knowledge sharing resources: systematic problem solving; experimentation with new approaches; learning from own experience and past history; learning from the experience and best practices of others; and transferring knowledge quickly and efficiently. Therefore, the knowledge source can also be the experience and history from the knowledge seeker himself or from other staff in the organisation.

Balance the knowledge sharing Tools and People

Organisations and some managers put a lot of emphasis on the function of knowledge sharing tools, especially technical systems. However, as discussed in Section 2.4, it is necessary to connect the technical components and the operational users. Thus, the skill of balancing knowledge sharing tools and people is essential for managers.

In accordance with the internal and external oriented knowledge source that is discussed above, Choi et al. (2008) also explored the way of gaining and sharing the knowledge sources. They stated two strategies, explicit-oriented and tacit-oriented, to deal with different situations. Explicit-oriented strategy attempts to share knowledge and increase organisational efficiency via codifying and reusing knowledge through

information technologies, while tacit-oriented method adopts a personalisation approach in that tacit knowledge is shared through direct face-to-face communication and by socialisation processes (Choi et al., 2008). The identification of a suitable method and finding the balance between tools and people who participate in sharing knowledge are necessary.

Communication

Effective skills of communication and conflict resolution contribute to the group coordination and teamwork collaboration, which can positively affect knowledge sharing activities (Pee & Min, 2017). In conducting a task or a project, individuals need different personal competencies. Koskinen, Pihlanto, and Vanharanta (2003) developed a knowledge tree model and divided individual competencies into explicit knowledge, tacit knowledge and personal characteristics. These three units together compose the personal competency of a project team member and assist them in performing tasks. To better share project knowledge, the project manager's first step should be to identify both explicit and tacit knowledge in team members and maximise the usage of their knowledge. Therefore, good communication skill from the project manager is very important, especially when the project is relatively short and team members are not familiar with each other.

Good communication needs to be intuitive to project managers, and a good project manager will have built upon previous experience triggers to begin communications at the start of a new project (Newton, 2012). The communication always involves both listening and talking. Newton (2012) described four key practices in improving project managers' listening skills, among which the accepting of regular reporting as part of the job is closely related to encouraging the sharing of knowledge. The regular report is a basic form of interaction and knowledge flows between project manager and team members. It is also a method to hear from or listen to the project members. In terms of talking, the skill of presenting complex information and knowledge in a clear way is essential (Newton, 2012). The information and knowledge, especially tacit project knowledge needs to be understood in a specific and vivid context. The project manager should be able to explain the knowledge in a detailed and clear way, especially for

sharing knowledge across different projects as the contexts might be significantly different.

As noticed by Choi and Lee (2002), in the domain of knowledge management applications, the most difficult question and the real challenge is how to find the link between knowledge management strategies and the knowledge management processes, i.e. how to identify the appropriate skills and align them to relevant processes in practice. Another concern is that despite knowledge sharing being largely adopted in organisations, the quality of knowledge being shared is questionable (Heisig et al., 2016); appropriate skills assisting the sharing process can help to improve the quality. Besides, skills and knowledge (domains) are not separate, especially for the role of managers within an organisation; a manager can improve individual skill through knowledge acquisition (Hu et al., 2015). Accordingly in the knowledge sharing area, the research on skills contributing to the sharing seeks to answer the question of 1) which knowledge is valuable to share and 2) how to deploy skills into practice, in line with the knowledge sharing processes discussed in the previous section (Choi & Lee, 2002).

2.5.5 Skill in project management sector

Skills in the project management sector have been widely discussed during the past decades. Project Management Institute (2007) documented nine essential knowledge areas (integration, time, cost, procurement, quality, communication, human resource, scope and risk) for project management, with the aim of standardising project management related knowledge and practice. The essential skills are also categorised into three dimensions: the knowledge competency representing the application of tools and techniques; the performance competency of managing knowledge and other resources to meet requirements; and the personal competency including their attitudes and core personal characteristics when performing activities (PMI, 2007). All three scenarios can affect project managers' performance in managing the entire project, and thus the competency of merely knowing 'how to do' is far from enough.

Back to the year of 1974, Katz proposed an approach of three sets of skills – human, technical and conceptual – to understand the performance of an effective employee

within the organisation. Many researchers have developed understandings towards these three sets of skills and added more content to them. El-Sabaa (2001) adopted this skill set in studying the career path of project managers: human skill enabling a project manager to work effectively as a group member and to build a cooperative environment in the team he/she leads; conceptual and organisational skill concerned with recognising how different functions of a project depend on one another and visualising the relationship of an individual project to the parent organisation; and technical skill implying the understanding of and proficiency in a particular activity particularly when involving methods, processes and techniques.

Dogbegah et al. (2011) investigated competency in the project management area by reviewing relevant literature and conducting an empirical study. He suggested that a main stream of current literature is focused on categorising and identifying criteria for a competent project manager; two widely-recognised types are worker-oriented and work-oriented competencies. Napier et al. (2009) classified project managers' skills into three categories: the performance skills representing occasions where the managers know how to do; the explicit knowledge skills in terms of project management tools and information technologies; and the personal skills relating to personal attributes and characteristics. Shi et al. (2014) investigated the skills of managers working in the construction consulting service, and identified the important relationship between skills and learning. For a manager to achieve success, personnel quality, onsite practical skills and continuing learning and obtaining professional knowledge are all important.

Despite the different and specific classifications, the discussion has mainly focused on two types of skills, namely technical skills and non-technical skills, with more emphasis on the latter. As argued by Edum-Fotwe and McCaffer (2000), with an increasingly professional demand for project managers, project managers are expected to supplement their technical and engineering expertise with non-engineering, social oriented skills. Nellore and Balachandra (2001) discussed the fact that usually a project manager appointed to the position based on the their individual technical ability, while lacking the necessary soft skills such as cross-functional management skill and leadership skill, which are usually learned and developed later while on the job. Therefore, the development of soft skills is important and usually more difficult for

project managers. One such example is that in the construction industry, project managers acquire valuable experiences and lessons whilst delivering professional and functional requirements in the construction project. The requirements may often exceed the boarders of technical knowledge in their expert field and encompass social perspectives such as preserving the right relationships and properly applying the required knowledge in the right place (Edum-Fotwe & McCaffer, 2000).

Many studies have been conducted to identify competencies or skills for project managers, seeking to tie these competencies or skills to project success (Blomquist et al., 2016). The concerns for project management competencies and project knowledge management skills have promoted the development of standards for project managers in terms of managing knowledge and project practices. These developments are largely based on qualitative research that has collected the opinions of experienced practitioners. There has always been an assumption that the standards describe the requirements of achieving effective project performance, therefore implying that the managers following the project skill standards for knowledge sharing perform more effectively than those whose performance does not satisfy the standards (Crawford, 2005). However, limited research has been carried out that either validates or challenges the assumption of the relationship between the standard skills and the actual project knowledge sharing performance. Therefore, the skills that directly contribute to knowledge sharing practice need to be explored.

2.5.6 Relating knowledge management skills and project management skills

In order to relate the skills in the existing literature to the context of this study, the table below summarises different types of skills that are crucial for both knowledge management and project management. On the basis of the skills for general project management, and with consideration of the characteristics of knowledge sharing, six sets of skills for the context of project management and knowledge sharing are summarised in Table 2.4.

Skills	Definition	Explanation and Example	Reference
Leadership Skills	The ability to form, define and share knowledge regarding to the future direction and success of the project, on the basis of recognizing attitudes, requirements and motivations of others, and in a manner of effectively inspiring them to learn and use the knowledge.	Motivate and garner enthusiasm from team members to share knowledge. Fostering a knowledge management and knowledge sharing culture that tolerates mistakes and cheers cross-functional and -discipline engagement. E.g. Recognise attitudes and sentiments that someone brings into a situation;	Napier et al., 2009; Donate & Pablo, 2015; El-Sabaa, 2001;
Performance Skills	The ability of both understanding specific processing stages in the project and the underlying knowledge accessed and used by these processes, and being able to externalise the understanding to others.	There are various stages and functions of a project that depend on one another. The performance skills refer to share the knowledge of not only processing activities, but also of envisioning the project as a whole that any single part can affect all others. E.g. Knowing and sharing 'how to do' in different occasions of a project. Being able to promote the best knowledge sharing practice in project and organizations.	Choi et al., 2008; Lord & Hall, 2005; El-Sabaa, 2001; Mueller, 2015;
Communication skills	The ability to interactively and effectively convey relevant knowledge to others, in order to enhance knowledge flow and ensure that the expected goal of communication is completed.	It also involves understanding what others by their actions and words (explicitly and implicitly), are trying to communicate, and being able to make themselves understood. E.g. Communicating ideas to others.	Napier et al., 2009; El-Sabaa, 2001; Bambacas & Patrickson, 2008; Pee & Min, 2017;

Managerial skills	Refers to the particular capabilities and work experience gained from organization and industry, to build and develop strategic tools that lead to successful knowledge sharing.	Managerial skills are usually gained through work experience. There are two types of managerial skills: specialist managerial skills and generic managerial skills. E.g. Building and developing a good framework for knowledge sharing.	Reich et al., 2012; Meridith & Mantel, 2006; Martinez-Conesa et al., 2017
Social-oriented skills	The ability to stabilize relations towards other members, groups, organizations and institutes in the working field, in order to attain others to cooperate and engage in collective actions, with the aim of achieving knowledge sharing success.	Mainly refer to building and maintaining optimal personnel relations. E.g. Knowing how to negotiation.	Edum-Forwe et al., 2000; Fligstein, 2000; Oluwaseyi & Raman, 2014;
Knowledge acquisition skills	The ability to acquire, retain and apply the necessary set of knowledge from current project and previous experience.	It involves both the current project and previous work experience. E.g. Apply solutions towards a typical problem from one project into similar situations in other projects.	Napier et al., 2009; PMI, 2007.

Table 2.4: A set of skills for the context of project management and knowledge management

Leadership skills are concerned with the capabilities of project managers in understanding, interpreting and sharing their knowledge regarding the vision and direction of the project (Napier et al., 2009; Li et al., 2017). Furthermore, leadership skills also involve emotional intelligence, i.e. project manager being able to share knowledge in a manner that encourages and garners enthusiasm from the knowledge receivers and therefore improves the knowledge sharing efficiency (Donate & de Pablo, 2015). Emotional intelligence is found to be helpful in establishing leadership and

sharing knowledge in terms of providing visions, encouraging enthusiasm and aspirating team members to meet high-performance standards.

Performance skills refer to the capability of understanding different processes of a project, not only knowing each process as a separate entity, but also envisioning the project as a whole and understanding the interconnections between different processes (Li et al., 2017; Lord & Hall, 2005). This can assist project managers in understanding the issues and problems that appear in the project, and in externalising individual knowledge in a more comprehensive manner. Performance skills are also relevant to project implementation related issues; performance skills enable the project managers to understand and share the 'know how' knowledge which is usually embedded within different processes of the project (Napier et al., 2009).

Communication skills refer to the capability in expressing knowledge in a clear manner, and in understanding the reactions and recognising the attitudes of knowledge receivers towards the knowledge being shared (Li et al., 2017). Communication skills are important in enabling project managers to organise and convey their tacit knowledge appropriately during knowledge sharing; this also assists the knowledge receivers in internalising the knowledge more efficiently. Besides, when a project involves stakeholders from different organisations, communication skills contribute to the accommodation of the expectations of various stakeholders through knowledge sharing (Sunindijo, 2015). Likewise, weak communication capabilities can negatively influence, and even end, the sharing and transmission tie of project knowledge (Napier et al., 2009).

Managerial skills are about developing and adopting strategic methods, including scoping the project, coordinating participants, considering political perspectives and technical issues (Sunindijo et al., 2017), to facilitate knowledge sharing in both direct and indirect ways. Managerial skills can be generally viewed as two types: the specialist managerial skills which are with strong technical foundations and can only be applied in some particular projects; and generic managerial skills that can be applied in different projects (Meredith & Mantel Jr, 2011). They are both important in facilitating

knowledge sharing activities, as the role of project manager is responsible for both sharing technical solutions to address problems and coordinating the project work.

Social-oriented skills refer to the capability in obtaining and sustaining cooperation from people that the project manager works with; this includes those within the same company as the project manager and those from other companies (Fligstein, 2000; Li et al., 2017). A stabilised and positive relation can assist project managers in gaining collective actions during the knowledge sharing processes and the project work. It also contributes to create a positive environment for knowledge sharing within the project team.

The idea of knowledge acquisition skills is to obtain useful knowledge, from the project manager's previous experience, from other similar projects, and from the project that is currently being undertaken, and then to apply the knowledge to solve problems that appear during project work (Napier et al., 2009; Li et al., 2017). This requires the project manager to be able to first identify the knowledge and second internalise the knowledge by themself. Knowledge acquisition skills are important especially in enriching the 'knowledge stock' of project managers.

To briefly conclude, this section is aimed at exploring the skills in the current literature and assisting the researcher in gaining theoretical sensitivity. There are studies with a focus on skills in both knowledge sharing and project management research. However, it is arguable that these studies are identically dispersed and in isolation, especially in the applications of skills that facilitate knowledge sharing in organisational operations and project practices. With this consideration, this study aims to fill the research gap through exploring and identifying the skills and their applications together with the knowledge that need to be shared in an integrative approach.

2.6 Knowledge sharing in construction projects and in China

2.6.1 Knowledge sharing in construction projects

2.6.1.1 Introduction to the construction industry and construction projects

Construction industry is a significant project-based industry composed of different unique projects, bringing a number of stakeholders, collaborating with each other, together at various stages during a project lifecycle (Dave & Koskela, 2009).

Kamara et al. (2002) simplified the construction process into four phases; project conception, design of facility, construction of facility and use of facility as shown in Figure 2.8. The client (investor) establishes construction requirements and passes a set of client demands to the phase of facility design. The construction management starts from this stage when the working team converts the user requirements into an appropriate facility design which is later passed on to the facility construction phase. The output of the construction is the completed facility which is then delivered to clients. According to the Construction Law in China, the architecture design and the construction need to be two independent parties (Wei, Liu & Wang, 2006). Thus in China, there are usually three independent parties involved in construction projects, namely, the investor establishing construction requirements, the design organisation planning and structuring the architecture, and the construction party in charge of the construction.

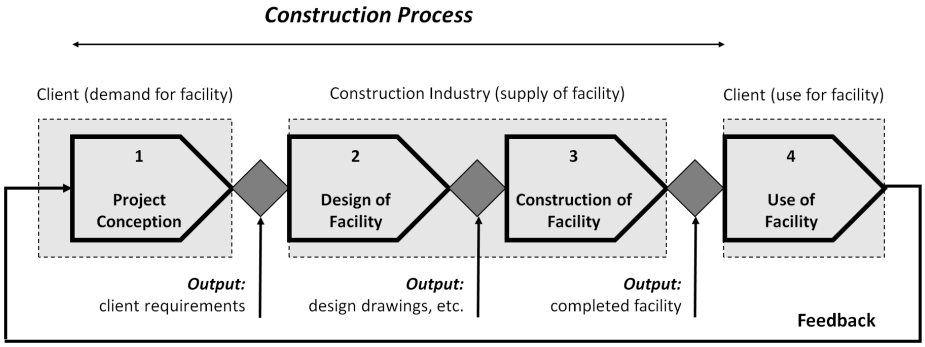


Figure 2.8: Simplified Model of Construction Process (Kamara et al., 2002)

A construction lifecycle includes a development phase, implementation phase and operation phase, which involve development management, project management and facility management respectively, as shown in Figure 2.9 (Xu et al., 2009). Project

management plays an important role in the whole lifecycle, designing the architecture, conducting the construction and performing pre-opening related work, while the development management and facility management cooperates and completes the whole processes. The development phase provides the idea of building a construction program; the realisation and facilitation of the program rely on the processes of construction project management, whilst the operation and facility management can only be conducted after the construction project has been completed.

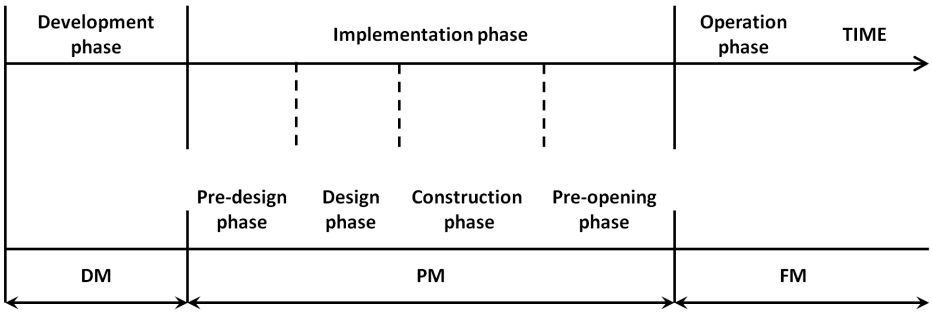


Figure 2.9: Construction Project Life cycle (Xu et al., 2009)

There are various definitions and scopes for construction projects. In this research, the construction project is defined at a relatively macro level, referring to the stages beginning from the investing company suggesting a project plan to the design institute's architecture, to the construction organisation completing the construction work at the site and ending at the time when the construction is completed.

Professional construction management refers to a project management team composed of professional construction managers and other participants carrying out the tasks of construction planning, design and construction in an integrated manner (Hendrickson & Au, 1989). Project management during construction operations is one main form of activity that mitigates risks via adjusting individual construction processes with the change of time and conditions (Golob, Bastič, & Pšunder, 2012). As the person mainly in charge of project management, the project manager undertakes the responsibility for the overall success of delivering the construction development without exceeding the constraints such as time, cost and user requirements (Edum-

Fotwe & McCaffer, 2000). This requires the managers to play a crucial role in both architectural and engineering construction activities. Particularly in obtaining construction projects, there is a trend that the traditional method of open-tendering is being replaced by the design-and-construction contracts, which influences the role of construction project managers (Edum-Fotwe & McCaffer, 2000). Such dynamics require the project managers to be equipped with higher managerial skills, as during the design-and-construction contract, managers from both design and construction parties are involved in many communications and knowledge exchanges.

2.6.1.2 Knowledge in construction projects

The knowledge acquired in the construction industry by project managers can be classified into two categories, namely, generic project management knowledge and particular construction engineering knowledge. Edum-Fotwe and McCaffer (2000) outlined nine knowledge areas that project managers are expected to obtain by combining the project management materials of Project Management Institute (PMI) and the Association of Project Managers. The nine classifications including integration, time, cost, procurement, quality, communications, risk, scope and human resources, are formed from generic management perspectives rather than requirements for professional construction knowledge. This is for the consideration that the knowledge areas needed by construction project managers have extended beyond the traditional engineering requirements and expand towards other generic management knowledge in the modern practices (Edum-Fotwe & McCaffer, 2000). In other words, project managers are required not only to obtain technical knowledge of the construction projects expressed as engineering accuracy and construction reliability, but also to equip themselves with other non-engineering knowledge and skills to facilitate better project performance and meet today's increasing demand competencies of project managers (Edum-Fotwe & McCaffer, 2000).

This research adopts the perception from Edum-Fotwe and McCaffer (2000) that the knowledge needed and shared by project managers consists of both professional engineering knowledge and general managerial knowledge. This is because 1) in the whole project, each project manager is not only in charge of an area where they have professional knowledge, but also the communications and sharing between different

project managers are more about managerial knowledge in terms of completing the project successfully; 2) this research adopts the methodology of Grounded Theory (which will be discussed in Chapter 3), and the findings will emerge totally from the practitioners' perceptions, i.e. from how project managers reflect on the knowledge that they consider important and need to share. Therefore, it is more reasonable for the researcher to have an open view at the current stage, rather than excluding any specific type of knowledge.

2.6.1.3 Knowledge sharing practice in construction projects

In practice, engineering construction includes the construction of roads and highways, bridges, railways and harbours, heavy industry, electricity generation and pipelines, water storage and supply, telecommunications and entertainments (Langdon, 2009). In each construction project, it is important to manage and share knowledge as it assists significantly in reducing the costs and improving the quality of construction projects via better knowledge flow within one project and through the reuse of relevant knowledge from other projects (Xu et al., 2009).

In today's dynamic economic and business environment, technology has been widely recognised as a useful tool in promoting construction knowledge sharing (Chen, Hsu, Luo, & Skibniewski, 2012). There are many studies focused on the practical application of knowledge sharing in the construction industry via technical support. For example, Ho et al. (2013) developed a technological Building Information Model to assist project managers and jobsite engineers to share knowledge and alleviate problems that appear at the construction jobsite. Chen et al. (2012) established a knowledge sharing model to evaluate and estimate whether risk mitigation through the use of derivatives would be beneficial for construction companies.

Despite various technical solutions, most of them only offer a type of communication platform which is hardly used to explain detailed tacit knowledge (Ahmad & An, 2008). It has been recognised over years that capturing and reusing valuable knowledge gathered in different construction projects pose a big challenge due to the fragmented nature of the construction industry and ad-hoc nature of construction projects (Dave & Koskela, 2009). As indicated in Figure 2.9 (page 75), construction projects are

composed of different stages. For example, in the first project conception stage, the client or investor explains the requirements and stakeholders communicate and share their views about the project and their own needs; it is the phase where interpretation and planning take place, and where project managers need to make decisions based on documentation, organisational and individual knowledge, and experience (Oluikpe, 2015). The knowledge generated in this stage needs to be used in the following stage. Each stage produces different but closely connected project knowledge, being performed by separate organisations with distinct cultures and knowledge (Xu et al., 2009). As a consequence, the knowledge, especially tacit knowledge produced in a project exists in different construction organisations, although the knowledge from the former stage organisation is significantly important for the organisation in charge of the next phase.

Furthermore, each construction project is unique and generates a significant amount of knowledge during its execution (Dave & Koskela, 2009), which remains mostly in people's minds and is not transferred across the organisation for reuse in future projects (Dave & Koskela, 2009). However, due to the dynamic nature of construction projects, new challenges come up frequently and solutions are quickly devised by experts and project teams. As a consequence, critical mistakes are repeated in different projects and construction experts have to "repeat the wheel" (Dave & Koskela, 2009). The tacit knowledge among engineers and project team members are not properly used to prevent such mistakes or to improve construction project quality (Xu et al., 2009).

Appropriate knowledge management can increase value-added to construction clients and improve construction competitiveness (Egbu, Sturgesand, & Bates, 1999). With many interrelated components working together in a complex manner, construction projects exist in a knowledge-intensive context where knowledge is mostly in tacit form and highly based on individual experiences or perceptions (Ahmad & An, 2008). The situations require an effective knowledge sharing atmosphere, and practices and personal skills to solve construction problems, especially in the context of China where some characteristics vary from western countries.

2.6.2 Chinese construction industry

The construction industry is regarded as one of the mainstays of national economy in a country, with construction products running at five to nine per cent in developing countries and around nine per cent in developed countries (Xu et al., 2009). In China, to accommodate the national rapid economic growth and the increasing demands for building and infrastructure, the construction industry has achieved significant growth in the past several decades (Shi, Chen, & Shen, 2017).

For many years the Chinese government has aligned the construction industry with the policy of urbanisation. The shifts of urbanisation process mainly appeared from 1949, the time of the foundation of People's Republic of China (Quan, 1991). Since its economy reform in 1978 till 2013, the urbanisation percentage has increased from 17.9% to 53.7% with the urban population growing from 170 to 730 million (SCIO, 2014). With the formulation of a new government group, President Xi Jinping has emphasized the importance of urbanisation and construction development in the 18th National Congress of the Communist Party of China in 2012. As a developing country, urbanisation is an important engine driving the way for Chinese economic and social transformation (Gu, Wang, & Ying, 2013). The construction industry plays unreplaceable role in the urbanisation in China. So far, the construction projects in Tier 1 cities, widely recognised as Beijing, Shanghai, Guangzhou and Shenzhen, have been generally completed to a high standard (SCIO, 2014). With the deep development of urbanisation, it is predicted that the focuses will be transferred to Tier 2, Tier 3 and Tier 4 cities, such as prefecture-level cities, distributed in different provinces in China. These places where either resident buildings or city constructions are not fully developed yet will be the areas for construction projects facilitations. Thus, the construction industry in China is very important and will be in further demand for the above reasons. Moreover, it also improves the infrastructure of the city and country (Edum-Fotwe & McCaffer, 2000).

However, the construction management and development is still considered as a major problem in China. The transitory nature of the change process makes it difficult to develop different approaches and management skills as they require a relatively long time; while the construction industry is faced with sustainable and ecological

challenges, which requires efficient management (Shi et al., 2014; Shi et al., 2017). There is still a long way to go in order to solve these problems.

2.6.3 Knowledge sharing in the context of China

2.6.3.1 Knowledge sharing practice in China

In China, the importance and practice of knowledge sharing have received increasing considerations during the past decades, as a result of its growing economy (Burrows, Drummond, & Martinsons, 2005). The Chinese government has reformed its economy and opened its market since 1978, raising a large number of enterprises and bringing great reforms to market structure. More recently, the government advocated the shift from an exclusive focus on economic growth towards an enhanced development of knowledge intensive industries (Borah, Zhou, Chen, & Nisar, 2017; W. Zhang & Zhang, 2018). This change in environment has triggered a growth in knowledge sharing and knowledge management practices, especially within organisational contexts. On the other hand, however, Chinese society is generally still based on traditional Confucian culture which places an emphasis on harmony, the saving of face and the networks of personal relationships, and these values shape the Chinese business context and organisational management practices (Cai, Jun, & Yang, 2017; Ramasamy et al., 2006).

The assessment and development of knowledge sharing in the context of China are still driven by the trends of following western standard-based experiences and practices (Chen, Partington, & Wang, 2008). The sharing of knowledge faces many problems including lacking its own managerial model and sharing inefficient, sustainable development through knowledge sharing, especially in the construction industry and projects where the knowledge is intensively generated (Shi et al., 2014). The dependence and use of western knowledge sharing theories and practices transferred directly into the Chinese context – project context in particular – are based on the assumptions that organisational and project management practices are context-independent and that the general managers and project managers should be able to apply the theoretical competencies to accomplish their tasks (Chen et al., 2008). However, knowledge sharing practices in China show that such assumptions need to be doubted and there are clear demands to understand Chinese knowledge sharing paths,

especially project managers' paths in experiencing western oriented knowledge sharing work within the Chinese context (Chen et al., 2008) .

2.6.3.2 Factors affecting knowledge sharing in China

Compared to its western counterparts, Chinese enterprises are still at an early stage of development and are faced with the problems of lacking economic market and management experience (Burrows et al., 2005; L. Shi et al., 2014). The particular national and social culture has shaped some unique characteristics in Chinese organisational knowledge sharing.

Collective Culture

Different to individualistic cultures – which indicate the tendency of people prioritising personal goals rather than social group aims – in collectivist cultures such as China, people are more social orientated and tend to give priority to the goals of their groups or organisations (Greif, 1994). Chinese people working together consider themselves as being so interlinked in a social group that any individual behaviour with the potential of threatening group harmony is deemed inappropriate (Young, 2014). When it comes to knowledge sharing, Ardichvili et al. (2006, p. 97) state that collectivistic members look for contextual metaphors in information and "*tend to disregard information in writing"*. In other words, Chinese organisational members tend to share knowledge through ways such as face-to-face communication and phone calls, rather than computerised systems.

Social network and shared goals are affected by the collective culture in China, and significantly influence the knowledge sharing activities, especially in terms of sharing tacit knowledge (Zhang & He, 2016). In addition, in collectivist cultures such as Chinese culture, people tend to have high perceptions and concerns for their face. Although collectivists are expected to put collective goal and interests above their own, they still feel a sense of deterrence from knowledge sharing especially when they assume that it could damage their face or social standing (Zhang & Ng, 2012).

Guanxi

The literal meaning of guanxi is 'a relationship' between two or more individuals implicitly based on sentiment, reciprocity and mutual interest (Huang et al., 2011). It

can be a process of social interaction that starts with two persons and then involves others at a later stage (Ramasamy et al., 2006). Since the Confucianism and harmony are highly valued in Chinese culture, people tend to put more effort into maintaining good relationships with the people in their surroundings. Su, Sirgy, and Littlefield (2003) specified that guanxi orientation and social orientation embody the culture of Chinese people and affects their behaviour during the social interaction processes; it is regarded as a basic interaction mode in China and is therefore an influential factor when analysing Chinese people's behaviour. People with a guanxi relationship are bound together via the networks of mutual interests, benefits and obligations (Newell, 2015). As a consequence, this is more likely to result in interactions, information and knowledge sharing between individuals.

In the Chinese business context, guanxi acts as the lifeblood in business communities and frequently plays the role of lubricant in business activities including knowledge sharing (Ramasamy et al., 2006). In organisations, employees exchange and share knowledge to help solve problems and expect to be helped in the future when they are in need. With guanxi culture in China, it is awkward for employees and managers to reject others' information and knowledge requests if they want to pursue or maintain a good guanxi with their colleagues (Huang et al., 2011). In this sence, guanxi is thus engaged in promoting knowledge sharing in organisations because with the aim of creating and maintaining good guanxi employees tend to respond to knowledge requests from their colleagues. People with higher guanxi orientation characteristics focus more on close human relationships and social surroundings and are therefore more likely to act as knowledge provider in knowledge sharing processes. This in turn could create opportunities for tacit knowledge sharing (Huang et al., 2011), as guanxi relationship is social and human based which involves more face-to-face communications. Besides, guanxi in China also means power, social status and resource transmission (Huang et al., 2008). As a relatively lower rule-governed society, guanxi brings social networks to people and makes it easier to complete certain tasks or goals if they have guanxi with 'internal people'. In the discussion of relationships and knowledge transfers, Ramasamy et al. (2006, p. 132) stated that "*China is not a rules based economy, at least not yet; it is still an economy based on relationship*", and thus

resources and knowledge are controlled by some prominent figures (whether in government or organisations). As a consequence, Chinese people tend to develop and expand their guanxi networks with the aim of becoming more integrated into society. The guanxi expenditure intention indirectly encourages people to share their knowledge.

However, guanxi could also negatively interfere with the sharing of knowledge. When a person is outside the guanxi circle of the knowledge senders, it is relatively difficult for that individual to acquire the needed knowledge. This can be very well described in some native popular sayings such as *Lew Yi Soow* ("to keep some of one's skills in secret") and *Fei Shui Bu Liu Wai Ren Tian* ("farmers keep their fertilizers from flowing into their neighbours' fields), which indicates the selfish nature of the Chinese in sharing knowledge with the fear of losing their competitive advantages (Ramasamy et al., 2006). This indicates that Chinese people and Chinese organisations may not share or disclose their knowledge to those who do not belong to their "in-group" or guanxi relationships.

Personal relationships are important in Asian businesses. Chinese people have the tendency of developing personal relationships with their business partners before further specific negotiations (Pheng & Leong, 2000). In the project environment, a project may involve people from different companies that did not know each other previously, and this can affect the communications and knowledge sharing behaviours during construction. In addition, in Chinese culture, talking directly about the problems or difficulties with a person in a public situation tends to be avoided in order to keep the general harmony of the situation (Pheng & Leong, 2000). In the project context this avoidance can be strengthened, as the team members are not familiar with one another. Knowledge sharing is aimed at solving problems and in this sense, the atmosphere of hiding difficulty would negatively influence project knowledge sharing practices.

The majority of knowledge sharing studies in China are focused on knowledge sharing barriers and how to remove these barriers, while very few have examined individual characteristics and contextual factors in knowledge sharing (Ma, Qi, & Wang, 2008).

However, project knowledge is created by individuals and the project environment affects individual's willingness to share knowledge. Ma et al. (2008) examined the factors affecting Chinese project knowledge sharing, stating that both intrinsically and extrinsically motivated individuals are likely to share more project knowledge with team members and that individuals with high altruism are more willing to share knowledge with others. They also found out that the group atmosphere of judgement and trust is vital in project knowledge sharing. With the collectivistic culture in China, group harmony and collective good are placed as top priorities compared to individual benefits. Thus, the project team relationships are important for encouraging members to share knowledge.

Face

The collective culture and social orientation demonstrates that Chinese people care about self-image and others' opinion of them, which in turn has developed Chinese people's strong intention in both avoiding losing face and gaining face in front of other people (Huang et al., 2011). Face refers to how other people think of a person, and Chinese people have a strong emphasis on "face saving" (Voelpel & Han, 2005). Although face culture is not unique in China, the "caring for one's face" is a significant part of Chinese consciousness (Huang et al., 2011). Under the influence of collectivism, "improper behaviour" such as making "simple" mistakes in public not only leads to loss of individual's face but also to loss of group's face. Therefore, losing face could seriously endanger individual's social position and relations with others, and as a result, efforts must be made to satisfy face requirements from both individuals and group members with the aim of maximizing face gain and minimizing the threats of face loss (Young, 2014). This could impact individual intentions on sharing knowledge, as employees who are highly sensitive in "face saving" would feel insecure and reluctant to share their knowledge due to fear for making mistakes in public. In Voelpel and Han (2005)'s study of Siemens ShareNet (a knowledge management system) in China, they found out that face concerns negatively affect Chinese employees' knowledge sharing behaviour because they are so worried about making mistakes such as grammar or spelling to harm the organisation's face. This is in accordance with the statement from Huang et al. (2011) that if Chinese people could not gain face during social interactions,

they will at least work on how to protect their face from being damaged. Young (2014) also examined the impact of face on knowledge sharing intentions in knowledge management system implementations, revealing that individual's face perception and concern towards "others' watch" and public self may impede their knowledge sharing intentions and behaviours. In this sense, face culture hinders individual knowledge sharing behaviours.

However, the culture and desire of face gaining would promote individual knowledge sharing activities. By displaying one's strengths especially in public, one could improve self-image and gain face (Huang et al., 2011), which encourages employees to share their knowledge with others with the aim of receiving public recognition, maintaining good reputation and enhancing social status.

Economic growth and governmental involvement

The very fast and dynamic development of the economy is a strong vehicle for knowledge sharing in China. As the world largest emerging economy, China has already become one of the most important foreign direct investment destinations for both foreign companies and multinational organisations (Voelpel & Han, 2005). The economic growth breeds an increasing number of organisations, together with fierce competition and strategic reforms. In these circumstances, enterprises are seeking competitive advantages. The overall unique business atmosphere promotes a dramatic increase of knowledge sharing practices in Chinese enterprises.

Policies and strategies from the government could be a particular knowledge sharing enabler in China. With the special political structure and disadvantage position in knowledge sharing activities. Xie, Wu, and Xiao (2002) suggest that the Chinese government could encourage and promote knowledge sharing and knowledge management via the market. For example, the government buys the specific knowledge and technology from developed countries and then applies these to domestic organisations.

Knowledge management, especially knowledge transfer in China is affected by its hierarchical culture. In a hierarchical and vertical culture, managers tend to control all the information flow and desire to restrict access to critical information, which could

impose barriers to knowledge sharing and transferring (Burrows et al., 2005). Due to the impacts of the hierarchy system, knowledge sharing and transfer are not common in China, especially in SMEs.

Trust issue in the period of economy mode transformation

Lack of trust is an important issue in the Chinese construction industry in general, reflected in different perspectives and areas such as low-quality construction projects, frequent postponement of project deadlines and weak knowledge sharing behaviours (Wei et al., 2005) linked this phenomenon to the fact that China is still under the way of its economic transformation from a traditional planning economy to marketing economy since the year of 1978. The trust in Chinese traditional culture is not strong or supportive enough to confront the modern market and economy mode (Wei et al., 2005). Specifically, the marketing economy requires correspondent political systems and trust systems to match its development, while in China such systems are not well developed yet. Especially in the construction industry where one single project requires long term delivery and the competition is fiercer compared to many other industries, the negative impacts of economic transformation is more obvious (Wei et al., 2005). This makes it difficult to encourage and promote the sharing of knowledge in the construction industry.

In the current literature, there have been some studies focusing on the knowledge sharing practices in the construction projects in China. For example, Xu et al. (2009) used a model of “islands of knowledge” to describe the knowledge in construction projects. They explained that the knowledge in construction projects, particularly tacit knowledge, exists in distinguished organisations, and due to a lack of proper knowledge sharing and knowledge management, the “islands of knowledge” are very common in construction knowledge. Most of the studies in this sector are still focused on a general level, while the specific considerations of social factors in China are relatively neglected. Particularly, the study of skills for knowledge sharing in the context of China is confronted with literature gaps.

2.7 Summary and implication to research

This chapter examined the existing literature with the aims of reviewing the research topic in the existing body of knowledge and establishing an area of contribution to knowledge. The literature review focuses on the theoretical issues regarding knowledge sharing and project, and contextual issues of knowledge sharing in the construction industry and in China.

To develop a conceptual awareness of relevant research themes, the tentative framework below synthesises the literature that has been summarised in Table 2.3 (page 38) and Table 2.4 (page 70). Table 2.3 provides a summary of four knowledge domains that are considered as important in the project context; Table 2.5 presents six skills based on general project management and with consideration of the characteristics of knowledge sharing. The tentative framework integrates these two dimensions, and consists of three main components including knowledge domains, skills and three phases of a typical construction project. In addition, this tentative framework informs the design of the interview guidance in the data collection stage, which will be explained in detail in Section 3.3.2 in the next chapter.

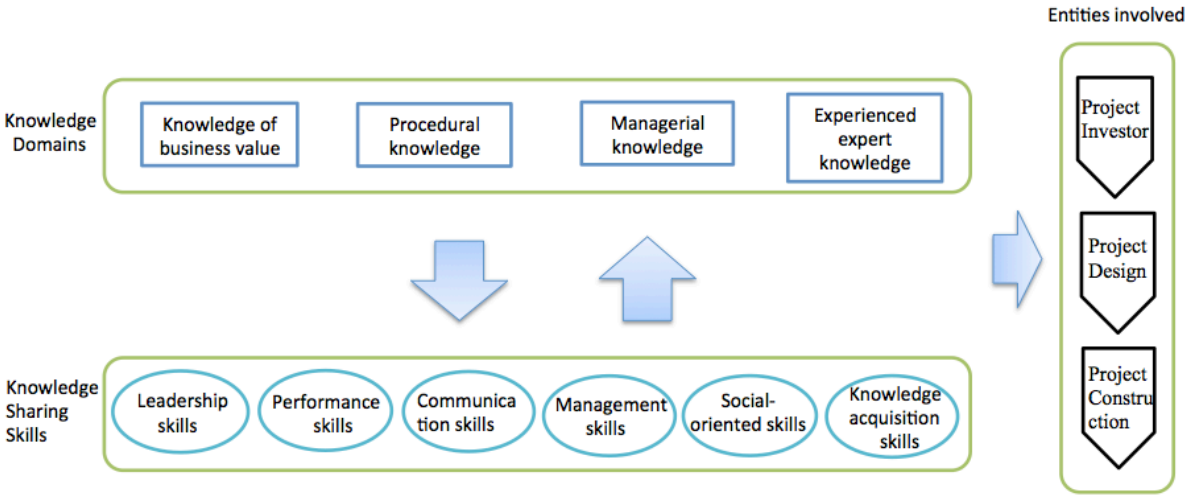


Figure 2.10: Tentative framework of knowledge domains and skills facilitating knowledge sharing

From the literature review, the following conclusions and implications can be drawn: 1) Despite a large amount of research on knowledge sharing, there is still a limited exploration focusing on skills that contribute to knowledge sharing within the context

of construction projects; 2) Studies contributing to the categorisation of knowledge domains or skills about knowledge sharing usually take the approach to investigate these two subjects separately without integrating them or exploring the specific relationships between them. A few studies (e.g. Hwang & Ng, 2013) attempt to relate them in the context construction projects, but these are based on quantitative methods without in-depth exploration. Therefore, a specific contribution can be made to fill this research gap by firstly exploring the knowledge domains and the skills which contribute to the sharing of these through an integrative approach, and secondly explaining the in-depth relationships between them.

Additionally, with regard to the context of China, most studies are conducted on the basis of general perspectives of knowledge sharing rather than a particular focus on skills, especially from the point-of-view of project managers. The influence of context, in terms of the influence of the Chinese culture on people's behaviour and management also needs to be considered in such an investigation.

This research project is expected to make contributions in filling the above literature gaps by exploring knowledge domains and skills for knowledge sharing in a Chinese construction project, and eliciting these domains and skills from how construction project managers construe and interpret them. Additionally, this research also provides an investigation and explanation about the relationships between the knowledge domains and skills, and how they affect project managers in terms of their knowledge sharing practice.

Following the literature review, it is necessary to select an appropriate methodology to assist in conducting the research in order to achieve the research aim and objectives. The next chapter provides a discussion of research methodologies and a justification for the methodology adopted in this research project.

Chapter 3: Methodology

3.0 Introduction

Methodology can be understood as the way of thinking and studying social reality, including a set of procedures and techniques to gather and analyse data (Strauss & Corbin, 1998). This chapter introduces Grounded Theory and case study, the combination of which is used as the method within this research. The selection of such a method is guided by the main research aim which is to identify skills that contribute to knowledge sharing from project managers' perspectives in the construction industry. Moreover, the choice of methodology is also based on an analytical comparison of different research methodologies and their implications.

In this chapter, the researcher aims to discuss the methodology employed in the study and present the rationale behind the choice. In doing so, this chapter is divided into six main sections. The first section is concerned with the underlying philosophical commitments of this research project, taking into consideration ontological and epistemological assumptions, deductive and inductive approaches, as well as quantitative and qualitative approaches to research. The second section reviews different qualitative research methods and presents the rationale for the research methods employed in this research project i.e. the combination of Grounded Theory and case study. The third section provides a detailed research design, discussing the theoretical foundation exploration, data collection and analysis techniques adopted in this study. Section 4 is concerned with the ethical considerations associated within the study, and the fifth section focuses on the validity and reliability of this research. The final section provides a summary and implication of the methodology chapter.

3.1 Research philosophy

The term "research philosophy" is concerned with the views and methodology that the researcher follows towards the development of knowledge (Saunders, Lewis, & Thornhill, 2009). All research is based on a certain view of the world, choice of methods and proposal of results (Thietart, 2001). The philosophical stance that the researcher adopts towards how the research should be conducted accommodates and affects the research process, which might in turn influence human knowledge in that

particular field where the research is aimed to exploring. Thus, philosophical foundations are considered as an important precondition for researchers to design and conduct research (Bryman, 2012); philosophical assumptions and the stance off each research should be made explicit.

As Saunders et al. (2009) stated, no research philosophy can be considered better than another, because they are "better at doing different things", i.e. one philosophical position might be more applicable than another for answering specific research questions, and it depends on how well the researcher reflects his or her philosophical choices upon their own research question that he or she seeks to answer. This section reviews the main philosophical foundations addressed by the research methods literature, namely philosophical assumptions, approaches, paradigms and methods. It also provides a general discussion on the stance this research has adopted at each stage.

3.1.1 Philosophical assumptions

In the field of social science, ontology and epistemology are widely recognised as the two main philosophical assumptions (Bryman, 2012). Ontology is concerned with the assumptions of the world as a 'being', while epistemology relates to what composes the knowledge in a particular field of study.

Ontology is focused on the assumptions about the nature of reality and its characteristics (Creswell, 2007). It mainly addresses the question of whether social realities exist independently from actors who participate in the society, or the social entities are built up from and interrelated to the actors' perceptions and actions (Bryman, 2012). In other words, ontology is about the assumption in which way the real world works – either social entity as something objective and external to its participants or as something subjective and being notably affected by social actors.

Encompassing this argument, ontology is classified into categories of objectivism and constructivism, respectively believing that social phenomena are separate from social actors, and that the two items of social phenomena and social actors are closely interrelated (Bryman, 2012). The objectivist position implies social phenomena confront us as external reality over which we as participants have no reach or influence

(Bryman, 2012). Saunders et al. (2009) used the example of management studies to explain this position: objectivism believes the essence of management functions is very much the same in different organisations, although the management structure performed by managers varies from one another. Opposing the suggestion that social entities such as organisation and culture are pre-given, constructivism asserts that social phenomena, together with their meanings, are actually continually being constructed by social actors (Bryman, 2012). In other words, different perceptions and sequential actions from various social participants create and shape the social world. More explicitly, Bryman and Bell (2015) suggest two assumptions from the constructivist position: the phenomena and corresponding categories are constructed via various social interactions; and the constructed phenomena and categories remain in a constant state of revision.

In this research, a subjectivist and socially constructed ontological position is applied. This study aims to explore a construction project that contains some facts such as project phases and organisational structure, and these are the realities that actors need to follow. The skills that contribute towards knowledge sharing will be identified from project managers, implying that the view of reality is resolved from actor's social construction in the reality.

Epistemology is a branch of philosophy that investigates knowledge in a field of study and is concerned with the validation of human knowledge (Bryman, 2012). It is the study of knowledge from different perspectives, including the nature of knowledge, the definition of knowledge, the generation of scientific knowledge, the value of knowledge, as well as in what method to validate the knowledge (Thietart, 2001). There are two main epistemological positions, namely positivism and interpretivism; the main difference between them lies in whether or not to consider the role played by human factors in the construction of social knowledge.

The advocated of positivism believe knowledge is an objective reality that has its own essence, existing independently from the research subject (Thietart, 2001). In other words, social knowledge as an object exists in itself without any influence from human actions, and the researcher must seek to discover it. Based on this belief and in

accordance with positivist principles, researchers generate research strategies for collecting and analysing data based on existing theories, especially through the development of hypotheses that testify them (Saunders et al., 2009). Furthermore, positivism is consistent with observations of the real world and assumes that social entities can be modelled, which is likely to be in favour of and similar to the methods employed by physical and natural scientists (Bryman, 2012).

Interpretivism, as a contrasting position to positivism, emphasizes the exploration and understanding of interactions between social knowledge and social actors (humans). It admits the distinction in conducting research among different social groups and the influences of social actors and their interpretations on human knowledge (Saunders et al., 2009). Researchers adopting this philosophical stance respect the differences between people (Bryman, 2012) and thus endeavour in exploring the substance of social phenomena from social actors' viewpoints. What should be noticed is that interpretivism shares some similarities with constructivism; for example they both consider the importance of human factors. However, they differ in the ideas that they attempt to focus on. Constructivism is aimed at explaining and constructing reality whereas interpretivism seeks to deeply understand it (Thietart, 2001).

In linking these philosophical commitments to the study of knowledge sharing, it is essential to acknowledge that tacit knowledge resides in peoples' minds and actions, and that the discovery of this tacit knowledge results from social interaction processes that are of critical importance for organisational development and competitive advantages. Knowledge sharing is a social process whereby individuals engage in the exchange and generation of new knowledge (Nonaka, 1994). Accordingly, the subjects in this project can be better studied by exploring and examining individuals' perceptions and interpretations. Moreover, the skills which are perceived by professional project managers are the exact focus of this research, which means the researcher needs to investigate and understand the actions undertaken by project managers when sharing knowledge, as well as to capture their perceptions and interpretations about their knowledge sharing experiences. Achieving this requires accessing a context and array of activities that is socially constructed, implying the

participation of project managers, as social actors. Therefore, interpretivist epistemology is in accordance with the aims of this study.

3.1.2 Research approaches

3.1.2.1 Deduction and induction

Based on the philosophical assumptions of constructivist ontology and interpretivist epistemology, in order to answer the research question and accomplish the research objectives, it is important to follow a specific approach, i.e. to decide whether the research should be guided by a theory or whether the research should be conducted through a series of procedures and build a theory as an end result (Bryman, 2012). In social studies, these two main approaches describing different relationships between theory and research are referred to as deductive approach and inductive approach, both of which are dedicated to the acquisition and generation of new knowledge (Hyde, 2000).

Deductive research is a process of theory testing, commencing with an established theory and seeking to identify its application and validation in certain instances (Hyde, 2000). In deductive studies, starting with the foundation knowledge of what is already known in a particular domain or on a specific theoretical topic, the researcher deduces certain assumptions (questions and hypotheses) and then verifies whether the theory is solid and accurate (Bryman, 2012). Trochim (2006) described the procedure of deductive approach as four sequential "top-down" stages. It begins with the researcher knowing an established theory about the topic of interest. Then in alliance with the research question, the 'established theory' is deduced and narrowed down to specific hypotheses that the researcher plans to test in the second step. Bryman (2012) added that the hypotheses should be expressed in operational terms and measurable variables in this stage. The third step consists of collecting data and observations with the aim of testing or verifying the constructed hypotheses, and finally a confirmation (or rejection) of the original theory is made.

The counterpart of deductive approach – the inductive approach – however is a "bottom up" process developing from observations to broader theory generation (Trochim, 2006). Inductive research usually begins with specific observations and

evaluations in a very particular area that one attempts to study. These data are analysed in forms of patterns and regularities, and further formulated as some tentative hypotheses that the researcher would like to explore. In the last stage, general conclusion and theory are generated on the basis of hypotheses. The inductive approach is more suitable for studies which use a small sample of subjects (Saunders et al., 2009).

As discussed in the literature chapter, there is a limited number of existing theories or models which focus on knowledge sharing practices and skills based on the perspectives held by project managers in the Chinese construction industry. This makes it quite difficult to form hypothesis through a review of the available body of literature. More importantly, the aim of this research project is to construct a brand-new framework detailing the skills enabling knowledge sharing for construction project managers. To achieve this, a deep understanding of the social context and rich data collection techniques that facilitate access to project managers' behaviours and perspectives are required. Thus, a theory building approach, namely inductive approach is very appropriate to be followed in this study. In addition, inductive studies are more likely to employ constructivist ontology and interpretivist epistemology philosophical commitments, because the evidence and observation that they start with may involve participants' interpretations and those of researchers' too (Gorman, Clayton, Shep, & Clayton, 2005). In this term, the philosophical assumptions discussed in the previous section and the research approach adopted are consistent with the objectives of this study.

3.1.2.2 Quantitative and qualitative

Quantitative research, as the process "entailing the collection of numerical data" (Bryman, 2012, p. 106), relies chiefly on numbers. It often refers to and relies on counts and the measure of things as evidence to test a theory or to draw a conclusion (Berg & Lune, 2007); it is therefore, often associated with a deductive research approach. On the other hand, quality refers to the essence and character of an object, more easily captured by what, how, when and where questions (Berg & Lune, 2007). Accordingly, qualitative research indicates the meanings, concepts, characteristics, symbols and descriptions of things rather than the counts or measures of things (Berg & Lune,

2007). Strauss and Corbin (1998) argue that an important and valid reason for choosing qualitative methods is the nature of the research problem, such as the researcher attempting to understand the meaning or nature of a social phenomenon, or a detailed experience. Although qualitative studies require a much longer timeframe and cannot be analysed via computer programs, they have significantly impacted social science (Berg & Lune, 2007).

It is meaningless to judge or show the superiority of these two paradigms over one another, as they play distinct roles for different purposes in the research. The qualitative paradigm is adopted in this research after considering that the research aims – developing an integrative framework of knowledge domains and skills facilitating knowledge sharing for project managers – means the researcher will be engaged in the production of knowledge via a social constructivist perspective, which is not based on a numerical or statistical study. The research question and expected outcome require the researcher to enter the research site and to capture and interpret knowledge sharing practices and skills from the perspective of professional project managers. It emphasizes the quality and interpretation of the data rather than the amount. Besides, qualitative research focuses on understanding the social setting via participants' perceptions, which is in alignment with the constructivist ontological position and with the interpretivist epistemological position taken by this research.

To conclude, it reasserted that there is no inherently superior philosophical assumption or approach. However, it is possible to align research aims and objectives with an ontology, epistemology and research approach that provide a better fit. Considering the aim and objectives of this research which are focused on the development of a framework of knowledge domains and skills in the context of Chinese construction industry, the philosophical foundations of this study require fidelity to social actors' perceptions, and result in a subjectivist and socially constructed, interpretive, inductive and qualitative research approach.

3.2 Selection of research strategies

Research strategy refers to the procedures and arrangements that one adopts with the aim of answering his or her research questions, achieving research objectives and

specifying research sources (Saunders et al., 2009). There are many different strategies available when conducting qualitative research. Given the topic this research and the specificity of the Chinese context and the industry it focuses on, the researcher adopts a combination method of Grounded Theory Methodology and the case study to conduct the investigation. This section will provide a rationale for this choice, making use of two sub-sections to discuss and clarify the methodology. The first sub-section provides a review of different qualitative strategies and the second part offers a clearer rationale for the combination of Grounded Theory and case study.

3.2.1 An overview of different research strategies

Saunders et al. (2009) identified seven different research strategies for social science research in information studies, namely experiment, survey, case study, action research, ethnography, Grounded Theory and historical research. Both experimental and survey designs are to a large extent recognised as quantitative methods, as they are aimed at examining or validating theoretical hypotheses via a large amount of data and a set of variables (Creswell, 2007). However, the skills for sharing knowledge that this study aims to identify is something performed by individuals in conscious and unconscious ways, which requires deep investigation and understanding of the research context rather than merely access to large amounts of numerical data. Thus, these two methods are not considered suitable to conduct this research. What follow next is a critical appraisal of different qualitative research methods, and a thorough discussion of each of them.

Historical research, or historiography, is a method focused on the investigation of past events that occurred during some certain periods of time in a specific research context. History conceptually means the past or the events that happened a long time ago. In a social science perspective, history refers to an account of an event or series of events in the past in a social setting (Berg & Lune, 2007). Historiography therefore is a research strategy seeking not only to discover these accounts of events with a centred focus on the fact, or what happened during a particular time period, but also to offer theoretical explanations for those events (Berg & Lune, 2007). Moreover, it is also used to complete organisational case studies and recover organisational life histories (Gorman et al., 2005), because historical research helps to reconstruct the organisational past by

identifying pieces of puzzles, putting them back together and providing a comprehensive sight of an event or a situation (Pickard, 2013). Pickard (2013) suggests the most different aspect of this method from others is that it largely relies on data that already exist in different forms while other research methods mostly design data generation as a part of the whole research process. Although having a realistic idea of the organisational past helps researchers to have a better concept towards the research context, it is not suitable to employ historical research methods in this study as it focuses on the interpretations of project managers in the construction industry, and these interpretations are new data that will be generated during the data collection stage.

Action research is recognised as a popular research strategy in the area of information and communication studies among practitioners (Berg & Lune, 2007; Pickard, 2013). It combines theory and practice via changes and reflections in a current problematic framework, requiring researcher and practitioners to work together in terms of diagnosis, action intervention and reflective learning (Avison, Lau, Myers, & Nielsen, 1999). Through these processes, the researcher can analyse practitioners' actions and reflect on how individual's changes in action can benefit or affect the community. Action research was firstly developed by the sociologist Kurt Lewin when he worked on individual influences in human dynamics, and believed that certain change or action needs to be embedded in a research design if the researcher wants to truly make a difference (Pickard, 2013). Embracing the concept of change, the action research strategy is best suited to situations where the practitioners are expecting to improve their organisational practice through development and analysis (Pickard, 2013). While this study is focused on the current situation of knowledge sharing practices in Chinese construction projects, there is no 'change' involved. In addition, there is no action such as the researcher getting involved in some activities or tasks with practitioners. Therefore, this method is not considered as being appropriate for this study.

Ethnography, also known as ethnographic field method is a common and long-standing research strategy in social science (Berg & Lune, 2007). It attempts to combine the view of an outsider with that of an insider in a social setting; the aim is to provide a description that is deeper and more comprehensive than the views from pure outsiders

whilst being less influenced by culture compared to the views from the insider (Pickard, 2013). In ethnographic field method the researcher is required to conduct field research and participate in the daily operation and life of the research context. The term ethnography refers to a process of getting engaged with the context and writing down analytical reflections on that engagement (Pickard, 2013). The essential core of this strategy is referred to as description, i.e. to observe, understand and describe "another way of life from the native point of view" (Pickard, 2013, p. 171). In this research, the researcher is aiming to investigating knowledge sharing practices and critical sharing skills that contribute to successful construction projects. The time span of a construction project, from investing and bidding to construction completion, could last for years, which makes it impossible for the researcher to spend such a long time only in conducting field observation. In addition, the main purpose of ethnography is to fully describe a social phenomenon from a comprehensive view, while this research project seeks to identify skills based on project managers' self-disclosed practice and behaviour, i.e. investigating an abstract, unconscious social behaviour that sustains a phenomenon. Thus, ethnographic field strategy is not the ideal choice for this project.

Ground Theory is widely recognised as a means to generate new theory relevant to the research area and discipline (Matavire & Brown, 2013). Following this method, theory is completely emerged and grounded from data collected via a series of observations or interviews (Goulding, 1999). In contrast to other qualitative research strategies, a very notable characteristic of Grounded Theory is that the researcher should not begin the study with a stabilised theory in mind. Strauss and Corbin (1998, p. 12) explained that this is to avoid the theory being "derived by putting together a series of concepts based on experience or solely through speculation that how one thinks things ought to work". Instead, Grounded Theory offers researchers a strategy to collect and analyse data, and generate new theory without the precondition of having abundant theoretical foundations in relevant research area or holding theoretically based preconceived hypotheses. As discussed in Chapter 2, the current literature provides very limited pre-defined knowledge or preconceived hypotheses. This has made Grounded Theory a suitable and applicable methodological choice. Furthermore, this study aims to produce a substantive conceptual framework on the basis of in-depth

investigation from multiple project managers' perspectives. Accordingly, the idea of grounding theory from data is appropriate in trying to achieve the research aims of this study.

Case study is a research strategy focused on understanding the social dynamics presented within a single research setting (Eisenhardt, 1989). It is widely applied in organisational studies and across social sciences such as in sociology and organisational psychology, providing an intensive and detailed analysis of the specific context and processes which illuminate theoretical issues relating to or even beyond the case being studied (Cassell & Symon, 2004). As staged by (Thomas, 2011, p. 43) "*The case study is not a method – it is a wrapper for different methods. It's the focus that is special to the case study – a focus on the singular*". Considering the requirements for rich data and for deep understanding of the various ways in which different project managers share construction project knowledge, it is reasonable to collect data within one or several single projects where project managers work towards the same goal via a combination of various skills. It works in a clearer way in illustrating different knowledge domains and skills compared to collecting data from project managers from very different construction projects. Thus, case study strategy provides an appropriate context in which this research can be conducted.

After reviewing different qualitative research strategies, Grounded Theory has been selected as the main research strategy for this study, combined with the use of case study. The major research procedures including data collection and data analysis will be performed according to the techniques prescribed by Grounded Theory methodology, and case study strategy is adopted to provide a solid research context, i.e. this research will be conducted in a case construction project. The following sub-section provides a rationale for combining Grounded Theory and case study as the method for this research; this complies with the research aim and objectives in this study.

3.2.2 Rationale for the combination of Grounded Theory and case study

The rationale for employing Grounded Theory in this research is based on the analysis of the research question guiding this study and on a review of Grounded Theory methodology as applied in existing studies. Goulding (1999, p. 8) described Grounded

Theory as a methodology that researchers could adopt "*when the topic of interest has been relatively ignored in the literature, or has been given only superficial attention*". The research topic in this study relates to skills facilitating knowledge sharing which are considerably underdeveloped in literature, particularly in a Chinese context. Besides, the aim of Grounded Theory is to generate rather than verify theory (Glaser & Strauss, 1967), and moreover it not only generates theory but also grounds the theory in data, i.e. systematically collects and analyses data to generate an inductive theory in a substantive area (Strauss & Corbin, 1998). Since this study is aimed at developing, instead of testing hypotheses relating to knowledge domains and skills, Grounded Theory as an inductive approach appears to be a suitable methodology.

In fact, at the beginning of the review, it was expected to identify a well-established framework from the literature in order to direct the data collection and analysis procedures. The existing studies, however, do not have any model or framework that can be directly applied to the research setting. As mentioned in Chapter 2, there are still literature gaps in the substantive area of knowledge domains and skills facilitating knowledge sharing particularly in the Chinese construction context. In this respect, Grounded Theory as a methodology that advocates "*the researcher does not begin with a preconceived theory in mind" and "allows the theory to emerge from the data*" (Strauss & Corbin, 1998, p. 49), can assist in representing the raw ideas from project managers and in generating the theory of skills that facilitate knowledge sharing in a clear way.

Particularly, evidence shows that Grounded Theory has been applied in organisational research and constructional studies and receives positive results (Graham & Thomas, 2008; Martin & Turner, 1986). In addition, the purpose of this study is to explore the personal knowledge sharing behaviours in the Chinese construction industry and how individual project managers apply their skills to facilitate knowledge sharing within one project as well as across different projects. The identification of knowledge domains and skills must precisely reflect and emerge from project managers' perceptions and interpretations, which bears affinity with symbolic interactionism and the notion that meaning must be "*socially constructed, negotiated and changed over time through the*

reflexive interaction of individuals" (Graham & Thomas, 2008, p. 170). Grounded Theory is suitable for studying such processes.

In terms of data collection processes in this study, the researcher needs to explore different perspectives from project managers and other participants for the purpose of theory development. Grounded Theory suggests "the best approach an initial, systematic discovery of the theory from the data of social research" (Glaser & Strauss, 1967, p.3). Instead of quantifying qualitative data, Grounded Theory adopts a coding process for the purpose of discovering concepts and relationships in raw data and then categorising them into a theoretical explanatory theme (Glaser & Strauss, 1967). Martin and Turner (1986) also noticed that Grounded Theory is particularly suited to deal with qualitative data gathered from participant observation, semi-structured or un-structured interview and case study materials. These methods typically generate large amounts of data that "accumulate in nonstandard and unpredictable formats" (Martin & Turner, 1986, p. 143). It is practically justifiable as it provides very systematic procedures for data collection and analysis by specifying clear rules and steps to be followed throughout the entire research (Cassell & Symon, 2004). Therefore it can be argued that Grounded Theory method also fits the data analysis requirements of this research.

Although Grounded Theory tallies with this research project as evidenced by the argument developed in the previous sections, an investigation always needs a significantly detailed design. Grounded Theory, regarded by Glaser and Struass (1967), is a methodology for generating theory grounded in data that is systematically collected and analysed. However, as one central feature is the constant comparative method, Grounded Theory sometimes is referred to more as a set of tools and analysis techniques, rather than an overall methodology (e.g. Pickard, 2013). More researchers tend to agree that Grounded Theory offers both an overall methodology and a set of tools and analysis techniques, and much depends on how Grounded Theory is adopted and used in the research (Mills, Bonner, & Francis, 2006).

In this study, the researcher adopts case study as the approach to contextualise the application of Grounded Theory. As Yin (2009, p. 18) clarified, " *you would use the case*

study method because you wanted to understand a real-life phenomenon in depth, but such understanding encompassed important contextual conditions – because they were highly pertinent to your phenomenon of study". Accordingly, case study particularly suits the situation where the boundaries between a social phenomenon and its context are not clearly defined, which is the case between the knowledge domains and skills, and the construction industry. Similarly, Thomas (2011, p.3) suggested that the case study method "*concentrates on one thing, looking at it in detail, not seeking to generalise from it*". In fact, there have been different researchers suggesting the combination of case study and Grounded Theory as it is very applicable for developing a valid inductive theory (Allan, 2003; Fernández, 2004). Furthermore, case study is particularly suited to investigate present phenomena embedded in real-life context, especially when the boundaries between phenomena and context are not clear (Allan, 2003). This research aims to investigate a present situation in the current Chinese construction industry and seeks to answer a 'what' question and to generate a valid theory, based on a deep exploration of the case context, through accessing participants' perceptions. In the investigation into knowledge sharing practices and skills, the boundaries of the construction industry are not explicitly defined between the 'phenomena' (the knowledge sharing practices and skills) and 'context' (the construction industry in China).

According to Eisenhardt (1989), there are three strengths in combining these two methods:

1) the outcome theory via this combination method tends to be novel, as creative insights into a case arise "*from juxtaposition of contradictory or paradoxical evidence* (p. 546)". The process of reconciling these problems encourages and helps researchers to reframe perceptions and has the potential to develop new theory with less researcher bias than those theories built from incremental studies or axiomatic deduction.

2) The emergent theory tends to be further expandable by subsequent studies, given the tight and convenient connection between the theory, the data and the context where theory is generated.

3) The generated theory is more likely to be empirically valid. A sense of validation is performed "implicitly" by the researcher throughout the theory-building process, via comparing and analysing data from the start (according to the procedures of Grounded Theory), which leads the theory to be consistent with empirical observation and closely backed up by empirical data.

When the research combines Grounded Theory and case study in the research design, it is necessary to specify how these two are combined and implemented in the research (Fernández, 2004). The Grounded Theory adopted in this study, specifically discussed in Section 3.3, provides clear guidance especially for the procedures of data collection and analysis. Case study is adopted as the research strategy that provides an appropriate research setting. Furthermore, the range of criticisms directed at case study typically argue that it is too descriptive (Gerring, 2004), which strengthens the rationale for adopting Grounded Theory to guide the data collection and analysis. The research question and objectives in this study are not only aimed at describing project managers' knowledge that need to be shared, but also at illustrating their skills facilitating knowledge sharing practices from tacit (when they use them unconsciously) to explicit, as well as to formulate a framework indicating their use of these. This process requires the guidance for theory emergence which is detailed by Grounded Theory procedures. To conclude, under the research strategy combining Grounded Theory and case study, Grounded Theory is selected as the major strategy in conducting data collection and analysis, while case study assists in contextualising the application of Grounded Theory in an appropriate social context, i.e. a suitable construction project in China.

3.2.3 Grounded Theory

This section expands the presentation of Grounded Theory as the methodology adopted in this study. It discusses the definition of Grounded Theory, presents its procedures and established the difference between two different Grounded Theory schools.

3.2.3.1 An overview of Grounded Theory

Grounded Theory, "the discovery of theory from data", was first developed by Glaser and Strauss in the early 1960s when they observed that in sociological research, methodologies and studies focusing on verifying existing classic theories thrive while those aimed at generating new theories barely exist (Cassell & Symon, 2004). Generated from data, Grounded Theory methodology intends to "improve social scientists' capacity for generating theory that will be relevant to their study" (Glaser & Strauss, 1967). It provides new insights emerging from the relevant contexts to understand certain social processes, without forcing or adjusting data to previous theoretical frameworks (Cassell & Symon, 2004).

With respect to data, Grounded Theory often combines different types of data collected by interviews, analysis of documents, and participative observation (Cassell & Symon, 2004). The aim of Grounded Theory is not to produce a perfect description of the area which the researcher is targeting, but to develop a theory reflecting much of the relevant behaviour (Cassell & Symon, 2004). The data are gathered via the development of the concepts, which means once no additional data is found, the researcher can develop a particular conceptual category (Cassell & Symon, 2004). By then, the 'theoretical saturation' is achieved and the theory is 'ready' (Cassell & Symon, 2004).

Grounded Theory has been applied in organisational research in various areas such as organisational culture, company innovation, work teams and organisational growth (Cassell & Symon, 2004). The studies with Grounded Theory application fall into two categories: those focusing on generating new hypotheses around a theme, and ones revealing social processes resulting in a certain phenomena (Cassell & Symon, 2004).

Methods evolve with time and even their prime advocators might diverge in terms of conceptualising the best way of developing theory (Fernández, 2004). This indeed was the case of Grounded Theory. The two co-founders, Strauss and Glaser were originally from different backgrounds when they started working together in the development of Grounded Theory methodology. Strauss was trained within symbolic interactionist tradition in qualitative research, also being influenced by the pragmatist philosophical

tradition. Glaser, on the other hand, had a quantitative methodology background and was an advocate of qualitative mathematics, a method that argues mathematical expressions can be qualitatively stated (Fernández, 2004). The combination of these disparate backgrounds contributed to the development of the constant comparative method (Glaser & Strauss, 1967) later known as Grounded Theory. In the 1980s and 1990s, however, Strauss and Glaser took different conceptual approaches in terms of the method's application, leading to what now is known as 'Straussian' and 'Glaserian' versions of Grounded Theory (Fernández, 2004). The disagreements between Strauss and Glaser were clearly illustrated by their sequent publications, Strauss and Corbin's book Basics of Qualitative Research in 1990 and Glaser's book Emergence vs Forcing: Basics of Grounded Theory Analysis in 1992. In general, Glaser extended Grounded Theory beyond the original text to detail more concepts such as theoretical sampling and theoretical coding, while it was Strauss and Corbin who focused on analytical techniques and on providing researchers with detailed analysis guidance to operationalise the Grounded Theory methodology (Heath & Cowley, 2004).

Glaser and Strauss are apart in terms of the starting point for Grounded Theory. Glaser (2002) believes that the researcher should start with 'an open mind' and the literature, to a large extent, should be avoided before the study takes place, as researchers are supposed to use their own 'concepts' generated from the data rather than using or even being forced to receive concepts from others. This suggestion alerts the researcher for the risks in pre-established assumptions towards the theme that one is about to research. Glaser further argued that with the Grounded Theory methodology, in the case the researcher holds deep beliefs about established theories, it is very likely that those established theories will affect the researcher's data analysis (Glaser, 1978) (Glaser, 1978). However, Strauss counter-argues that reviewing literature does not mean researchers will use theory or experience as data per se. He further argues that analysing data cannot completely ignore prior studies and understandings, and it could be claimed that lack of understanding is fundamentally flawed (Heath & Cowley, 2004). Fernández (2004) also emphasised that the critical point is that the research does not start with an established theory or aim to prove that a theory in the literature is right or wrong. Strauss also recognized the advantages of reviewing the literature at early

stages of the study, as it helps develop a general awareness of the field, although it should not preconceive theoretical conceptualisations resulting from data analysis (Strauss & Corbin, 1998). In terms of data analysis procedures, Glaser's approach and Strauss' approach differ from each other in operational terms, especially in terms of the recommended approaches to coding; Strauss introduced the 'axial coding' process and the theoretical outcome (Straussian full description versus Glasian abstract-conceptualisation) (Fernández, 2004).

A third Grounded Theory approach is proposed by Charmaz (2000), recognised as the constructivist Grounded Theory. Charmaz proposed that researchers need to go beyond the surface in seeking meanings inside the data, and to search for and question the meanings of values and beliefs; this is underlying the assumption that interactions between researchers and participants can produce the data which are the meanings that the researchers observe and identify (Mills et al., 2006). This opposes to the classic version built by Glaser and Strauss (1967) in terms of research data. Studies adopting Charmaz (2000)'s method are mostly found in disciplines of education, psychology and nursing, where the researchers referred to the work of Charmaz to formulate their arguments for a constructivist approach to their studies (Mills et al., 2006).

In this study, the researcher does not aim to enter the dispute that has been metaphorized as *"a war of words between friends"* (Fernández, 2004, p. 46). On the contrary, the researcher acknowledges that both approaches are valuable contributions to qualitative research and furthermore, many Grounded Theory researchers have already left the debate and are more focused on the improvement and application of the methodology (Graham & Thomas, 2008; Van Niekerk & Roode, 2009).

3.2.3.2 The implementation of Grounded Theory in this study

Although the two founders had different opinion towards Grounded Theory, the fundamental principles of this methodology have not differed significantly from the ideas contained in the original publication (Heath & Cowley, 2004). Both Glaser and Strauss agreed that Grounded Theory is a qualitative research method that systematically utilises a set of procedures to develop an inductive theory that should

provide a fitting explanation for a certain social phenomenon (Niekerk & Roode, 2009). They also agree on the fundamental principle of ensuring theory emerges and is grounded in the data (Niekerk & Roode, 2009). Therefore, this study follows the guidance from the original version of Grounded Theory, especially in terms of the constant comparison method and theoretical sampling strategy which were proposed by Glaser and Strauss (1967) and which have been agreed between them since. This will be further discussed in the research design in Section 3.3.

In terms of data analysis, Glaser and Strauss (1967) proposed an approach that combines two procedures of data analysis. The first procedure is explicit coding, where incidents or concepts are coded from data and into categories through constant comparisons. In this procedure, categories emerge "*as data emerge that fit an existing category*" or generate a new category; whilst the comparisons soon start to generate theoretical properties of categories (Glaser & Strauss, 1967, p. 105). The second procedure consists of analytic procedure for theory development. In this procedure, categories are compared and refined according to their properties and relationships, and the theory is developed. The application of constant comparison method throughout these two procedures and the joint coding and analysis allow more systematic generation of theory (Glaser & Strauss, 1967). In this research, the data analysis followed these two procedures as proposed in the original Grounded Theory methodology; this will be discussed in detail in Section 3.3.3.

3.2.4 Case study

3.2.4.1 An overview of case study

In the conduction of case study strategy, it is important to consider the position of case study within the research and select appropriate kind, purpose, approach and process (Thomas, 2011) according to the research subject, aim and objectives.

There are three kinds of cases: key case which is classic or exemplary and illustrates something from in-depth study; outlier case that provides an 'outlier' identification showing something is different by its 'specialness' and 'differentness'; and local knowledge case where the special and own knowledge of the researcher leads to the selection of the case (Thomas, 2011). With consideration that this research project is

about knowledge sharing within construction projects, which requires an in-depth investigation into the construction project as the context, a key case of a construction project is appropriate for this investigation.

In regard to the purpose of a case study, Thomas (2011) categorised it into intrinsic, instrumental, evaluative, explanatory, and exploratory. Yin (2009) further explained three types of purpose: “explanatory” case study which provides insights into a phenomenon with the aim of indicating why or how something is as it is; “exploratory” case study that illustrates broader topics such as the conclusion or outcome of particular interventions; and “descriptive” case study detailing how things are in a particular case or a group of cases. The research questions addressed by this case study focus on the capacities and skills for knowledge sharing which are acquired but not explicitly known by project managers, and thus the researcher will need to conduct investigation into some unknown areas. This is generally regarded as exploratory. More importantly, this research seeks to understand and explain the knowledge domains and skills, as well as the relationships between them, within the case study; its purpose is for “*in-depth understanding and potential explanations based on depth of understanding*” (Thomas, 2011, p. 101). Therefore, the purpose of case study in this research is a combination of exploratory and explanatory.

The approaches for case study include testing a theory, building a theory, drawing a picture, experimental, and interpretative (Thomas, 2011). As explained in the above section, this research aims at theory generation which is grounded from the data obtained in the case study field. From the perspective of how many cases are adopted in the research, case study strategy is divided into single-case study and multiple-case study. It is not necessary to discuss whether one is better than the other, as stated by Yin (2009), the adoption and application of case sites relate to the “decision”, namely, the major focus of research; the case sites can be “individuals”, “organisations”, “processes”, “institutions”, as long as it is in accordance with the aim of the research and assists in the research conduction.

In this research, the single-case study is adopted. Instead of the commonly cited case of a single company, the single-case study here is contextualised in a single

construction project. As discussed in Chapter 3.1 and illustrated by Figure 12, one construction project consists of a process comprehending investors conceptualising and proposing the project, an architecture organisation responsible for designing, planning and controlling the time span of the project, and the construction company devoted to executing the construction. These three organisations work together as a temporary institute towards the same goal of completing the project successfully. The aim of this study is to identify knowledge domains and skills that facilitate knowledge sharing from project managers, using a construction project as a contextualised case to conduct the research. Thus, the single case study in this research refers to a single construction project, consisting of three inter-independent companies communicating and cooperating to complete the case project.

In summary, this research adopts Grounded Theory methodology within the context of a single-case study. It is essential to select an appropriate case-study site (a construction project in China) to conduct data collection and analysis, which is further discussed in the following sub-section.

3.2.4.2 Application in research project

The construction project, C Hotel, is adopted as the research site for this study. C Hotel project is based in Xingtai, a medium-sized city with a rich history of 3500 years. The city of Xingtai is located in the south of Hebei province, north China, with a distance of 396 kilometres from the capital Beijing (which is considered a small distance in China) and functioning as an important centre connecting the eastern seaboard area, northern area and central plains of China with access to two railways and fourteen high ways. According to its government website (www.xingtai.gov.cn), Xingtai is a prefecture-level city and the government is aiming to increase its development in urbanisation in the next 20 years. This is in accordance with the policy of central government and promotes the growth of the construction industry in this city.

The construction project of C Hotel started in June 2011 and was completed in May 2015. It was proposed, designed and constructed according to the standards of five-star hotels; in fact, it is the first five-star hotel in Xingtai city. Within this project three companies were involved, namely, C Group Ltd as the investor and time-scale

controller, AD Institute as the architecture designer, and CP Ltd as the constructor. C Group Ltd is a privately owned, or non-state owned, enterprise based in Xingtai City and founded in the year of 2004. The company has more than a thousand employees and is focused on business areas of supermarket, restaurant, chain hotels and international travel. AD Institute was founded in the year of 1959 and was one of the earliest institutions in Xingtai City that provided comprehensive investigation, architectural design and consultancy services. It has developed to become the largest architectural design institution in Xingtai City nowadays. CP Construction Ltd is a construction company located in Shijiangzhuang city, the capital of Hebei province. It provides services in building structure construction, electricity and water circulation construction, and interior and exterior fixtures construction. Within these three organisations in relation to the C Hotel project, eleven project managers participated and contributed to the project, including eight from the C Group Ltd, two from the AD Institute and one from the CP Construction Ltd. The C hotel belongs to the investing company, i.e. the C Group Ltd, for both the construction and the operation after the construction is completed. Figure 3.1 links the case conceptualisation as the sequence of construction processes, which matches construction companies typical workflow previously presented in Figure 2.8.

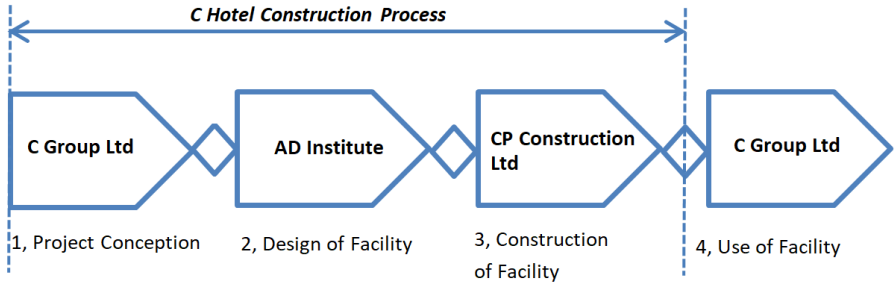


Figure 3.1: Construction processes of the C Hotel

The project of C Hotel is selected for four main reasons. Firstly, it is a typical construction project with a time span of around four years, participants from three independent parties, i.e. investor, designer and constructor, and a total number of

twenty-seven project managers. It is expected that this case project will provide rich and useful information into project managers' knowledge sharing practices, which assists directly in achieving the research aim of this study. Secondly, C Hotel project has the completion date of May 2015, and the researcher started data collection from July 2015. This guaranteed the accurateness of project managers' memories when they were asked to recall their knowledge sharing practices during interviews. Consequently, it helped in producing more vivid interview data, and it helped keep the data collection within the planed time frame for the overall investigation. Furthermore, as discussed when the urbanisation policy was introduced in China in Section 2.7 and as described in the city development plan of Xingtai in this section, the construction projects in this city enjoy wide recognition. C Hotel, as a newly developing construction project under such social atmosphere, receives more recognition from stakeholders both inside and outside the project. This, to some extent, makes the project managers more aware of and responsive to project performance, and thus constitutes an advantage for the researcher who aims to identify project managers' successful knowledge sharing practices and skills. Finally, from an operational point of view, the researcher obtained access to the relevant participants, i.e. project managers, the general manager, the chief engineer and project members involved in this project. This practically supports the conduct of this research.

Gaining access can be a tough proposition, especially if the potential interviewees are those playing important roles in industrial or organisational context (R. J. Thomas, 1993). It is also suggested that to obtain access, participants should have the choice of venue and interviews should be held in a quiet, private environment (Whiting, 2008). Although there are many factors associated with the responses from interviewees such as familiarity with the research context and communication about the research, in the context of China, managers rarely would be willing to be interviewed by someone they did not know or did not have a relationship with (Su et al., 2003). Such relationship between two or more individuals implicitly based on sentiment, reciprocity and mutual interest is defined as 'guanxi' in China (Huang et al., 2011). Su et al. (2003) specified that guanxi orientation and social orientation embody the culture of Chinese people and affect their behaviour during social interaction processes. Moreover, a lack of trust

and the fear of sensitive answers which might be used in the research and might have consequences for their future career also makes it difficult to conduct interviews with them (Katyal & King, 2014).

Understanding the context of guanxi was fundamental in gaining access and trust from interviewees and thus obtaining data. With three individual organisations involved in this case study, it is essential to obtain access permissions three times from each one of the organisations. Considering that Xingtai Architectural Design & Research Institute, the design institute placed at the centre of the workflow (as shown in Figure 3.3), performs as a bridge connecting the other two organisations. Therefore, the initial contact was with a chief engineer in the architectural design institute, who then assisted in contacting some of the subsequent participants. Interviewees were initially approached beforehand by both mobile phone messages and email, briefed about the objectives of the research and set the scene for data collection. With the evolvement of data collection and analysis, according to the need of theory development, the researcher later approached the investing company where the internal contact of the chief engineer had better links with and the construction company.

3.3 Research design

A research design provides a specific action plan to guide the data collection and analysis. In this research project, the research design is composed of three main components. The researcher conducted an initial theoretical foundation exploration with the purpose of increasing theoretical and contextual sensitivity. Then, the research data was collected and analysed coherently, to respond to the research question and develop a theoretical framework.

The Grounded Theory method incorporates the process of data collection and analysis. Data collection serves the aim of generating theory whilst the researcher jointly collects, codes and analyses the data in order to decide what data to collect next and where to collect (Glaser & Strauss, 1967). Therefore, the data collection and analysis are interrelated and coexist in this study.

3.3.1 Theoretical foundation exploration

In contrast to other qualitative research strategies, a very notable characteristic of Grounded Theory is that the researcher should not begin the study with a stabilised theory in mind (Glaser & Strauss, 1967). In fact, Glaser and Strauss (1967) indicated that researchers should start with an "open mind", to avoid being "constrained" by the prior theories and concepts. This demonstrates that the review of literature needs to be conducted cautiously; it should serve the purpose of exploring theoretical foundation for the research.

Nonetheless, there is a difference between an "open mind" and a complete ignorance of the literature at the start of the study. There is a need for the researcher to be "sufficiently theoretically sensitive" in order to conceptualise and formulate the theory as it emerges from the data (Glaser &Strauss, 1967). Also, the concern should not be whether to use existing knowledge, but how (Strauss & Corbin, 1990). Therefore, an initial theoretical exploration was performed in this study, which covered the general areas about knowledge sharing as the theoretical background of this study, and the project management and the Chinese construction industry as the context of this study. This is for the purposes of improving the understanding of the research literature and context, and therefore enhancing the researcher's theoretical and contextual sensitives. During this process, the researcher bore in mind the necessity of keeping a distance from being 'constrained' by the existing theories.

Different areas of knowledge sharing studies were explored, including concepts of knowledge and knowing, knowledge sharing and factors affecting knowledge sharing, skills relevant to knowledge sharing, and the context of project management and the Chinese construction industry. Despite a large number of valuable resources retrieved, it was discovered from this exploration that there is a limited number of studies directly linked to skills for knowledge sharing within the project management and construction industry setting, and even less connecting the skills to particular domains of knowledge.

The theoretical exploration led to the emergent of a number of theoretical constructs and the development of a tentative framework, consisting of an overall view of skills

contributing to knowledge sharing and knowledge domains, shown in Figure 2.11 in Section 2.8. As pointed out by Strauss and Corbin (1998, p.51), these constructs can be used to *"formulate questions that act as a stepping off point during initial observations and interviews)"*; after the first observation(s) or interview(s), the researcher can adjust the questions on the basis of concepts that merge from the analysis. The tentative framework in this research was used in the initial step towards designing an interview script for the first set of interviews. Specifically, the higher-level components of the framework, i.e. the knowledge domains and skills affecting to knowledge sharing were used to formulate the two main sections of the interview script, namely, the knowledge domains, and skill sections. The elements inside each general component were used to improve the researcher's theoretical sensitivity, in order to develop follow-up questions and come up with in-depth questions in a timely manner that respond to the research question during the interviews, which will be further explained in Section 3.3.2.

Theoretical and contextual sensitivity were developed through the literature review. For instance, theoretical sensitivity was enriched via conducting a general review about knowledge sharing in projects and understanding all matters relating to skills and practice; contextual sensitivity was enhanced by reviewing the issues in the construction industry and in the Chinese context. As a result, the literature review functioned as a rich source for the researcher to stimulate thinking about properties and asking conceptual questions during the data collection stage. The use of literature in developing theoretical and contextual sensitivity also helps in terms of data analysis. As explained by Strauss and Corbin (1990), by understanding and using literature in an appropriate way, the researcher becomes sensitive to the meaning of the data, rather than forcing personal explanations about it.

3.3.2 Data collection

Data gathering techniques are always coupled with theoretical perspectives during the research process, and are therefore associated with theoretical orientations, topic choosing motivations and analysis (Berg & Lune, 2007). This section presents the adoption of theoretical sampling strategy and semi-structured interview method for data collection in this research project.

3.3.2.1 Theoretical sampling strategy

Theoretical sampling was employed in this research as the data collection strategy, and was used to provide constant direction for the researcher to obtain data for the further development of the study and the generation of theory. Defined by Glaser and Strauss (1967, p. 45), theoretical sampling is the process of "*data collection for generating theory whereby the analyst jointly collects, codes, and analyse the data and decides what data to collect next and where to find them, in order to develop the theory as it emerges*". Therefore, the data collection and analysis start almost at the same time, i.e. the analysis begins as soon as the first collection is obtained, rather than the traditional methods where data is collected based on hypotheses and analysis begins after completing the data collection process (Fernández, 2004). Furthermore, the decision of who is the next interviewee was dependent on the result of systematic analysis rather than the researcher (Goulding, 1999).

In this research, at the beginning of data collection, the initial sampling decisions were planned in advance by the researcher. The initial decisions for theoretical collection of data should only be based on a general subject area or a general sociological perspective (Glaser & Strauss, 1967). Based on the fact that this research project aims to investigate the skills facilitating knowledge sharing and required by project managers, the initial data collection started with the project managers from the Xingtai Architectural Design and Research Institute – the design institute within the project.

When conducting the data collection, a digital recorder was used to record the conversations accurately. Immediately after each interview, the digital voice recordings were verbatim transcribed into text documents, and the researcher developed brief analysis by using the first coding process as introduced in Section 3.2. Besides, each transcript was carefully checked with consideration of context and content accuracy before being analysed or before moving on to the next interview. Such precautions minimise the risk of bias, especially for the fact that the research conclusion is drawn and grounded from the data (Allan, 2003).

The discovery and collection of research data was controlled by the emergence of new theory rather than being affected by the researcher's subjective willingness or any

preconceived theories (Goulding, 1999). Consequently, decisions in terms of whom and where to sample next, within the social context of the case-project involving people with different backgrounds and responsibilities, was made and judged by the emergence of theory and by the requirements for new data discovery, assessment and refinement. As the research progressed, concepts and categories began to merge; further selection of informants in this study was depending on the result of the previous analysis.

During this process, constant comparison was used to compare similarities and differences from the previous analysis results in terms of the concepts and categories, as the guidance of where the next data collection should take place. In Grounded Theory, an important feature of sampling is that it applies constant comparative method. Comparative analysis should be used jointly with theoretical sampling strategies for collecting new data (Glaser & Strauss, 1967). It is an on-going interaction or interplay between data collection and analysis; the researcher compares and analyses data after each round of collection with the aim of identifying concepts, categories or relationships, and then starts a new round of collection according to the analysis (Bryman, 2012).

Gaining access can be a tough proposition to interviewing, especially if the potential interviewees are those playing important roles in industrial or organisational context (Thomas, 1993). Although there are many factors associated with the responses from interviewees such as familiarity with the research context and communication about the research, in the context of China, managers rarely would be willing to be interviewed by someone they did not know or did not have a relationship with (Su et al., 2007). Such relationship between two or more individuals implicitly based on sentiment, reciprocity and mutual interest is defined as ‘guanxi’ in China (Huang et al., 2011). Su et al. (2003) specified it that guanxi orientation and social orientation embody the culture of Chinese people and affect their behaviour during social interaction processes.

The researcher sought to apply personal ‘guanxi’ and relationships to the research project with the aims of gaining access and trust from the potential interviewees and

thus obtaining data. Considering that there are three organisations involved in the project and that the researchers' best personal guanxi contact – a chief engineer is in the architecture design institute, participants from the design institute were first. After interviewing the informants from that institute and learning more about the project, the researchers approached the investing company where the internal contact of the chief engineer had better link with. After establishing relationships with the investor, the construction company was approached with the help from a key project manager in the investing company. In addition, the data collection and analysis procedures illustrate that applying 'guanxi' through the access point did not affect the data collection procedure in terms of gaining response and insights from the participants.

Another challenge the researcher experienced was the differences in employee titles between the western and the Chinese settings. The role of project manager referred to in this study was not always called 'project manager' in the research case project. In fact, the three participating organisations have their own titles for various positions. Following the theoretical sampling strategy, the immediate transcribing and brief analysis assisted the researcher in identifying not only subsequent informants, but also prospective participants that functioned as the role of an actual 'project manager'. In the end, one senior manager, one chief engineer and several team members were interviewed in addition to the project managers. The senior manager from the investing company and the chief engineer from the architectural design institute were closely linked to and in charge of project managers in the hotel project. The five team members undertook some role of coordination in addition to their own engineering work in the project, and also communicated frequently with project managers.

Specifically, the following figures 3.2, 3.3 and 3.4 illustrate the structure of each participating company within the project. The theoretical sampling strategy guided the data collection in the case-project where three organisations were involved, and resulted in a total number of twenty-one interview participants in a total number of 21 twenty-one interviews. The summary of participants is indicated in Table 3.1.

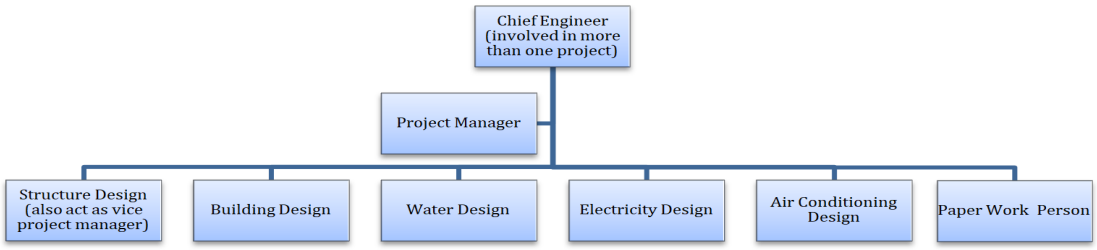


Figure 3.2: Structure of the design institute in the C Hotel Project

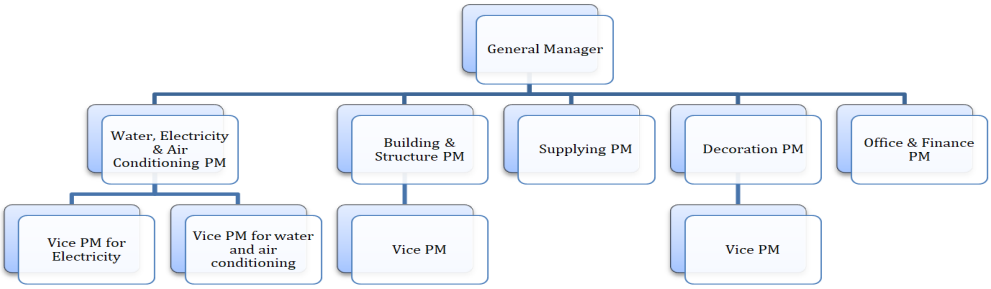


Figure 3.3: Structure of the investing company in the C Hotel Project

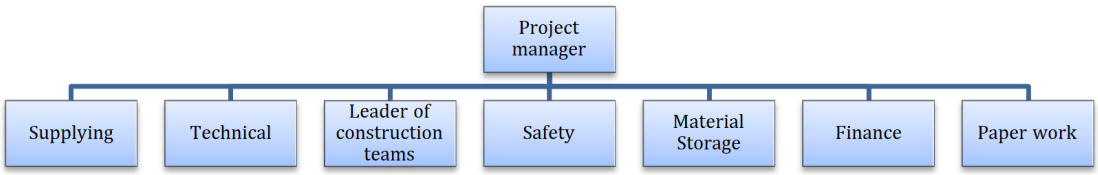


Figure 3.4: Structure of the construction company in the C Hotel Project

Name of Organisation	Professional Position	Years of Experience	Gender of Participant
AD Institute (The Design Institute)	Project Manager	20	Female
	Vice Project Manager	18	Male
	Chief Engineer	28	Male
	Team Member	5	Male
	Team Member	4	Female
	Team Member	6	Male

	Team Member	5	Male
C Group Ltd (The Investing Company)	Project Manager	26	Male
	Project Manager	20	Female
	Project Manager	23	Male
	Project Manager	25	Male
	Vice Project Manager	9	Male
	Vice Project Manager	12	Male
	Vice Project Manager	10	Male
	Vice Project Manager	12	Male
	Senior Manager	29	Male
	Team Member	4	Male
CP Construction Ltd (The Construction Company)	Project Manager	12	Male
	Leader of Construction Team	15	Male
	Technical Member	6	Male
	Supplying Member	3	Male

Table 3.1: Interview participants in the research

The gender of participants reveals a difference in terms of female and male project managers, as well as senior manager and team members. In fact, the construction industry shows a strong characteristic of employing more male than female professionals (Sunindijo & Kamardeen, 2017). However, the data analysis in this research did not reveal an influence of gender on the findings which will be presented in the next chapter.

3.3.2.2 Semi-structured interview method

As discussed in section 3.2, qualitative research is concerned about the interpretation and practice of reality, and aims to provide details and in-depth insights into social phenomenon (Denzin, Lincoln, & Giardina, 2006). Qualitative studies usually employ three types of data collection methods, including observation, interview and focus group. In order to effectively respond to the question of this research, interview has been decided upon as the most appropriate data collection method for the reasons discussed below.

Firstly, for practical considerations, it was not possible for the researcher to practise observation in this study. The case project was constructed over a time period of more than three years, which is longer than the average period of a PhD study. Moreover, in order to gain comprehensive overviews and perspectives from the project managers, the time for data collection was chosen after the construction project had been completed, which meant the researcher could not use observation method.

Secondly, it was difficult to organise focus groups involving project managers from all the three participating companies, as they had completed the case project and were involved in different and tight times schedules for their own work by the time of data collection – even for the project managers from the same company, after the case project of this research they started working on other different projects. Besides, in Chinese culture people tend to speak only positive things in front of their working relations in order to maintain a harmonious relationship, focus group method is not helpful in identifying critical and difficult moments of knowledge sharing during the project.

Finally, interview is the most widely employed method in qualitative research, especially for case studies (Bryman, 2012). It yields rich insights into people's experience, values and attitudes by generating conversations about a specific topic or range of topics (May, 2011), and therefore greater reliability could be placed on the data generated via interviews where a list of questions are self-completed by interviewees (Allan, 2003). Although the data collection procedure could also involve various types of sources such as documents, videotapes and anything that might answer or affect research questions, Grounded Theory is particularly suited for studies with data generated from semi-structured and unstructured interviews (Martin & Turner, 1986). Particularly, in the face-to-face situation the interviewer could check on whether the participant is the appropriate person to answer the questions; and the interviewee is able to discuss questions in details (Allan, 2003). Besides, for the purpose of investigating knowledge sharing behaviours from project managers in this study, a deeper interaction exploring the tacit information and knowledge they have and share is more appreciated.

The form of interview varies from highly formalized, structured with standardised and constraining questions for each interview participant, to informal and unstructured conversations between interviewee and interviewer (Saunders et al., 2009). One typology for categorisation which is commonly used therefore, is according to the level of formality and structure; interviews could be classified into structured, semi-structured and unstructured or in-depth interview. The one adopted in this study is semi-structured interview where researchers acquire a list of themes and questions that needed to be covered while omitting some questions in some particular interviews (Saunders et al., 2009). The order of questions and wording could be modified during an interview according to the researcher's perception of what seems the most appropriate (Robson & McCartan, 2016). In this way, the interviewees are given plenty of leeway in how to respond to the interviewer's reaction, which gives a greater degree of latitude to the interviewees and meanwhile assures that the interviews do not drift away from the topic of discussion.

The structure of the interview questions was developed on the basis of the tentative framework from the literature review, as mentioned in Section 3.3.1. It is important to re-emphasise that the tentative framework was a result of the process of enhancing theoretical and contextual sensitivity, and has very little impact on the data analysis and theory development. After the first round of data collection, the interview questions in the transcript were instantly evolving due to the adoption of theoretical sampling strategy and constant comparisons.

The interview questions were designed in three sections: general research context; knowledge domains; and skills contributing to knowledge sharing. The section of knowledge domains serves as an important path to the investigation of skills, as the questions within this section provide the scenarios for participants to recall and deliberate the skills they utilised in order to share these knowledge domains. Each section consisted of a series of open-ended questions, which assisted the researcher in receiving useful responses from informants for the needs of theory development. Furthermore, under each semi-structured question, several trigger and follow-up questions were developed for the purpose of assisting the researcher in raising more in-depth questions according to the previous response, as well as in informing the

interviewees about the level of response that is expected. For language concerns, the interview questions were written in both English and Chinese; the English terminologies assisted the researcher in being aware of theoretical sensitivity, and the Chinese questions were directly used to interact with informants.

The data collection was conducted almost in parallel with data analysis. The participants were approached individually according to the needs for theory development, which was obtained from the previous data analysis. After each interview, the audio recording of the interview was immediately transcribed into text and briefly analysed according to the open coding method. The results from the brief analysis were used immediately to revise the interview questions and to indicate who should be the next informant. In conducting interviews, the interview questions were constantly developing with the ongoing data collection and the results of analysis. The data collection stopped at the time when theoretical saturation was perceived as having been achieved, which will be discussed in the next sub-section.

During the conduction of interviews, the interview questions script (see Appendix 1) was a useful tool, not only in presenting the interview questions but more importantly, for the researcher to take brief memos during the interview process. The memos were useful in the following data analysis in terms of guiding the researcher to identify new emerging areas and modify the interview questions.

3.3.3 Data analysis

Grounded Theory facilitates iterative data collection and analysis by the analytic procedure of constant comparison. As indicated in the above sub-section, data collection in this research followed the constant comparison analysis suggested by Glaser and Strauss (1967). Initially data analysis was done coherently with data collection, and continued afterwards. This section explains the data analysis processes in detail, with the outcome of the generation of the integrative framework.

3.3.3.1 Coding and category development

Coding refers to the analytic processes via which data are fractured, conceptualized and integrated into the formalisation of a theory (Strauss & Corbin, 1998). It is a fundamental analytical process performing a crucial role in analysing, organising and

making sense of textual data (Basit, 2003). Glaser and Strauss (1967) proposed a coding process that consists of two procedures: the explicit coding procedure and the analytical procedure. In fact, the first two coding stages proposed by Strauss and Corbin (1998), open coding and axial coding, are largely aligned with the two procedures suggested by Glaser and Strauss (1967). What differentiate these two versions of Grounded Theory are the selective coding and conditional matrix in Strauss and Corbin's (1998) version, which this research did not adopt or follow.

Constant comparison is the central method for Grounded Theory (Glaser & Strauss, 1967). The two rules that researchers should follow are "1) *while coding an incident for a category, compare it with the previous incidents in the same and different groups coded in the same category … 2) stop coding and record a memo on your ideas*" (Glaser & Strauss, 1967, p.106-107). The constant comparison method was applied throughout the two coding stages in this research.

In the explicit coding procedure, the analysis starts by comparing and coding each incident from the data as concept and into categories; this allows category to emerge, or data to emerge to fit in an existing category (Glaser & Strauss, 1967). This is the first step of theory building, with the aim of conceptualising, defining and developing categories together with their properties and dimensions (Strauss & Corbin, 1998).

There are three ways of coding in this procedure, including line-by-line analysis, sentence or paragraph analysis, and entire document analysis. The line-by-line way of coding was criticised for its two main disadvantages: it is time consuming and can lead confusion due to focus loss (Allan, 2003). Taking this into consideration, the researcher conducted coding by analysing sentence by sentence in the interview transcript.

All the interview transcriptions were imported into the software Nvivo and were stored separately. Nvivo is one of the most commonly adopted software applications for coding qualitative data. In this study, it was used as a platform that allows coding to take place. The coding activities conducted in Nvivo included creating new codes, linking quotations to codes, and comparing the new emergent codes to the existing categories and codes. The screenshot in Figure 3.5 provides an example of the use of this software. Moreover, Nvivo also enabled the researcher to retrieve and manage the

interview transcripts. For example, when the researcher needed to retrieve a quotation and find out from which interview it belongs to, she could search the name of the code in Nvivo, and the relevant information would be displayed. Additionally, the unique indicator for each quotation presented in the Chapter 4 Findings and first section of the Chapter 5 Discussion was generated with assistance from Nvivo. For example, "*PMD – I1 – 182-184*" means the interview is taken with the project manager from the design institute; it is the first interview transcript being analysed, and the quotation is from lines 182 to 184 in the transcript.

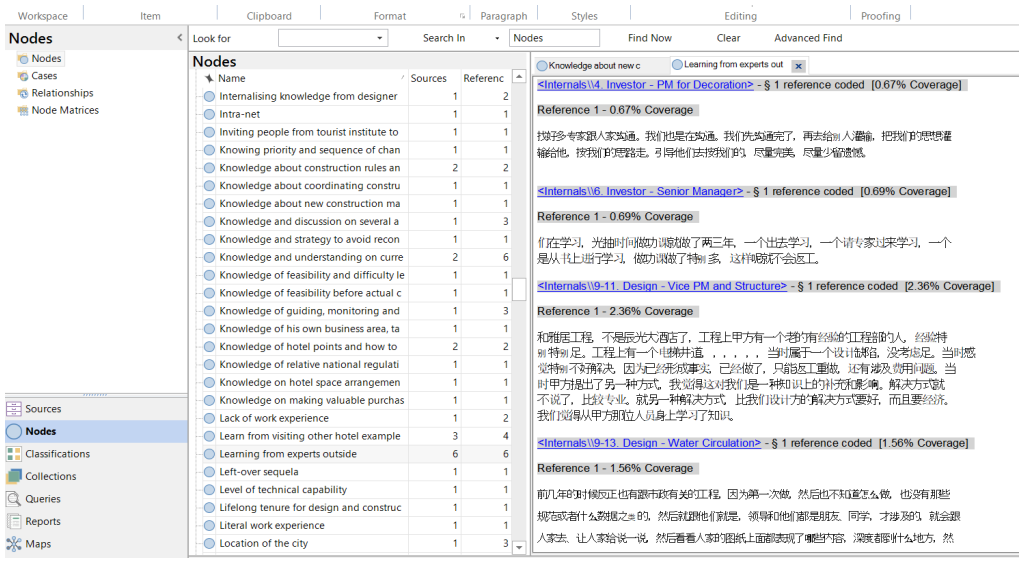


Figure 3.5: Example of using Nvivo for coding

For the analysis, the researcher began to search for codes and identify the emerging properties and dimensions, starting from the first interview transcript. Relevant data were labelled and either created as a new code (shown as 'node' in Nvivo) and given a definition, or assigned to the existing codes with memos indicating their relevance and potential properties or dimensions. Through this, the data are broken down into different units of meanings, i.e. different concepts. The concepts as the basic units of analysis in Grounded Theory, refer to a labelled phenomenon representing an event, action, objective or interaction which researchers view as significant in the raw data (Strauss & Corbin, 1998).

No.	Code	Definition
20	Personal understandings towards construction regulation items	Project managers need to know about construction rules, how to implement them in the project, and share their knowledge towards the rules with relevant members, so that their work can meet the official standards while maximizing the facility functions.
21	Feasibility of construction plans before actual construction	Personal opinions of whether the construction plans and ideas are feasible based on their understanding of the industry and investigation of other construction examples. *(They may go to other cities or sites to investigate.)*
22	Identification and investigation on similar projects	The skill to identify current completed construction projects that are similar the one they work on, and the skill to practically investigate and learn from these examples (in terms of when there are some problems or innovation issues, how these examples dealt with relevant issues).
23	Skill of responding quickly	Being able to respond to other's questions quickly by offering an appropriate answer. Even if the question is not very relevant to the project manager's own knowledge area, the project manager can still offer some guidance in terms of who is the appropriate person to consult.

Figure 3.6: Example of code definition list

Figure 3.6 presents an example of the codes together with its definition in the data set. The coding definition list is a helpful tool adopted for analysis at this stage. The codes for the analysed data are abstract representations of an event or object, compromising key words or phrases and being used for comparisons (Strauss & Corbin, 1998). The emergent code analysed from the data was compared with the existing codes in the coding definition list in terms of similarities and differences. As suggested by Glaser and Strauss (1967), while coding a concept, researchers should compare it with the previous ones in the same category. The definition list adopted in this study assisted the researcher in conducting constant comparisons, as each open code is presented with its definition which is defined by its meaning and positioning. The results of this comparison process determined whether the emergent code should be combined with existing codes, or be generated as a new code in the coding definition list. Furthermore, through the constant comparisons, codes were categorised alongside the properties and dimensions of categories being developed.

Sub-Category	Code	Definition of code	Quotations
Analytical skills	Skill of cross-functional and integrational thinking	Skill of considering other functional areas when his own expertise area is under design or construction, and integrating all functional areas without conflicts. It also involves the skill of reminding others to be aware of cross-functional issues.	沟通主要是在结构施工的时候需要考虑其他专业。因为结构是先施工的，在建筑施工的时候考虑其他细部，考虑水暖电，还要考虑消防。 One of the main communications is that when the structure part is under construction, he (the structure PM from investor) needs to consider other functioning areas. Because structure is the first part to be constructed, the PM needs to concern about other details, watering circulations, heating, electricity and extinguishing protections. 我不能说我比较全面吧，基本上来说我是搞建筑的，基本后边这几年通过锻炼，工程上面基本上是都用，虽然不精但是比较通。 I cannot say I'm so comprehensive. But I've been working in construction industry for many years. Through the practice, I understand (every functioning areas) well in general, although not expertise in all of them. 最起码我们五个人合作的话，肯定有自己专业牵扯到其他专业，最起码就是要考虑到各专业相互之间需要提供…的话，给提供过去… 你看我是做暖通吧，可能需要电，点可能需要用电设备这些东西，不可能让他直接等着吧，因为我们首先大体方案，把设备先布置那儿，把电给他布置过去，然后再做。不能说我们先做好以后再让电去做，这样不是事先… 就是考虑到各专业吧，我是最起码电上的，电上的话我先大概供个把设备供那儿，就是后期后边做电设备的能先画，就是前赶工期吧。 At least for the five functioning areas, we need to cooperate when our own area is related to other areas... For example for the heating system, when it requires electricity… I cannot let him wait all the time. So we have an initial general plan and put the facilities there, and then conduct it. I cannot let the electricity area to wait until we all finish our own… Consider all functioning areas. For example I would put the facility there on the picture and design details later, so that other functioning areas can do their work too.

Figure 3.7: Example of quotation list

The coding definition list was another tool adopted in the data analysis, which connects an open code with all relevant quotations. Figure 3.7 presents an example of the quotation list. The quotation list was also useful in the comparative analysis in terms of both comparing codes and categorising a code into a category. Comparing the quotations of the emergent code to the quotations of the existing codes enabled the researcher to make decisions with the new emergent code and meanwhile develop properties and dimensions for the relevant categories.

As codes and categories started to emerge, the constant comparisons change from comparing codes to codes towards the comparison of codes with properties and dimensions of categories (Glaser & Strauss, 1967). In order to facilitate better comparisons and categorise the codes under relevant categories, the researcher also adopted a text-based manual approach to compare the codes and sort them into categories of related meanings according to their properties and dimensions. Each code together with its definition and quotations was put into a Microsoft Word document and then printed out on paper. The researcher manually grouped the emergent codes into existing categories or created a new category. Figure 3.8 showed an example of this manual approach. During the procedure of open coding, the researcher continuously compared the codes or concepts between existing and new

emergent data, and systematically discovered relevant properties, characters and dimensions from the codes. Codes pertaining to the same or similar phenomenon were grouped under a higher classification leading to categorisation of the data.

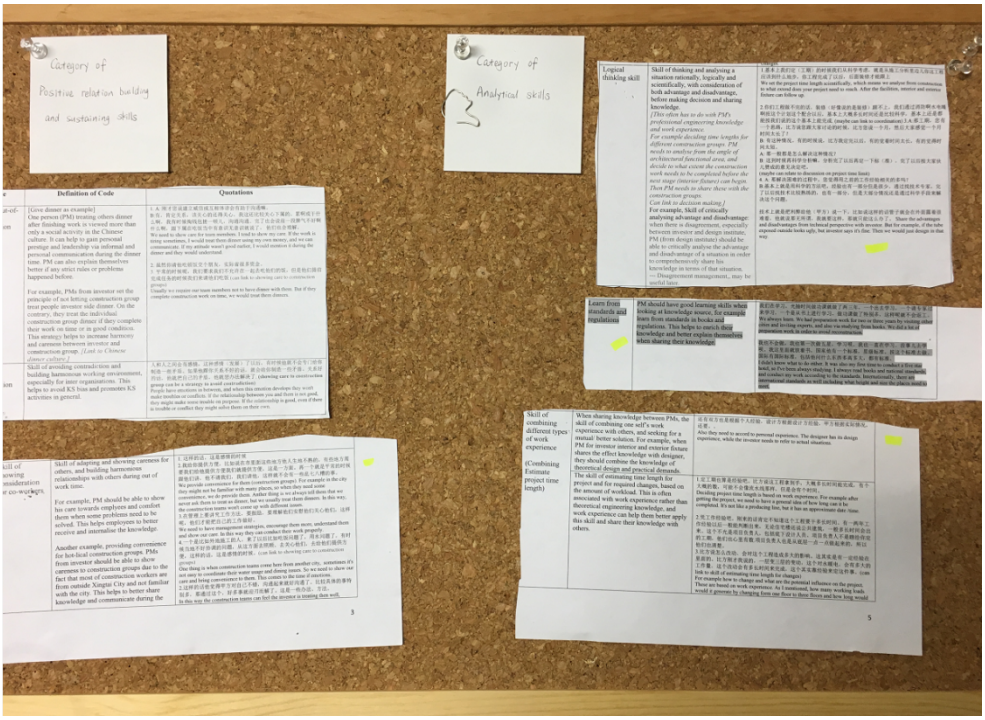


Figure 3.8: Example of text-based manual approach for comparisons

In developing categories, discussions in memos are useful in providing the content and the considerations behind each category (Glaser & Strauss, 1967). In this research, memos were taken at the initial analysis and continued afterwards, along with the code definition list, quotation list, in word documents, as well as being written down on papers. Figure 3.9 shows an example of a memo that the researcher used to understand the structure and the actual role of project managers in the design institute. The use of memo assisted the researcher in keeping records of the analysis; furthermore, the considerations being noted down contributed to explore the relationships between concepts, sub-categories and categories in the analysis.

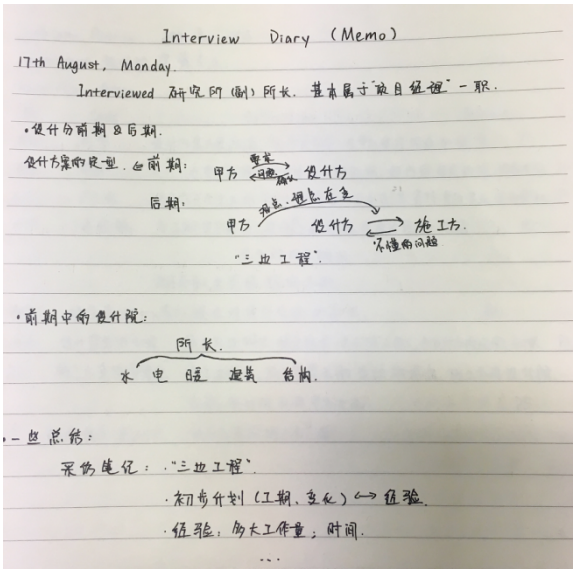


Figure 3.9: Example of memo

After the explicit coding procedure, the data were conceptualised, defined and categorised in terms of their properties and dimensions in this research. As theory develops, the following is the analytical procedure. In this procedure, "Reduction" is the most important part, as the analyst discovers "*underlying uniformities in the original set of categories or their properties, and can then formulate the theory with a smaller set of higher level concepts*" (Glaser & Strauss, 1967, p. 110). Therefore, categories and their corresponding sub-categories are linked (Strauss & Corbin, 1998). The purpose of this procedure is to reduce and cluster the existing categories, as well as to sort out relationships between categories and sub-categories, concepts and concepts through the method of aligning the lines of their properties and dimensions (Heath & Cowley, 2004).

During the analytical procedure, the researcher started by comparing the properties and dimensions of the emergent categories. In order to constantly analyse and compare the categories, concept map is adopted as a diagrammatic tool to support the analysis and to visualise the findings. Using diagrams can assist the data analysis, especially in analysing the relationships in terms of 'why and how' between categories (Strauss & Corbin, 1967). The researcher completed a set of concept maps to visualise and present the identified categories. Figure 3.10 indicates an example of the concept map. It demonstrates the relationships and dimensions among the emerging

categories, and facilitates the comparative analysis between sub-categories and categories. The produced concept maps, and the discussion of each category and its dimensions, will be presented in Chapter 4 Findings.

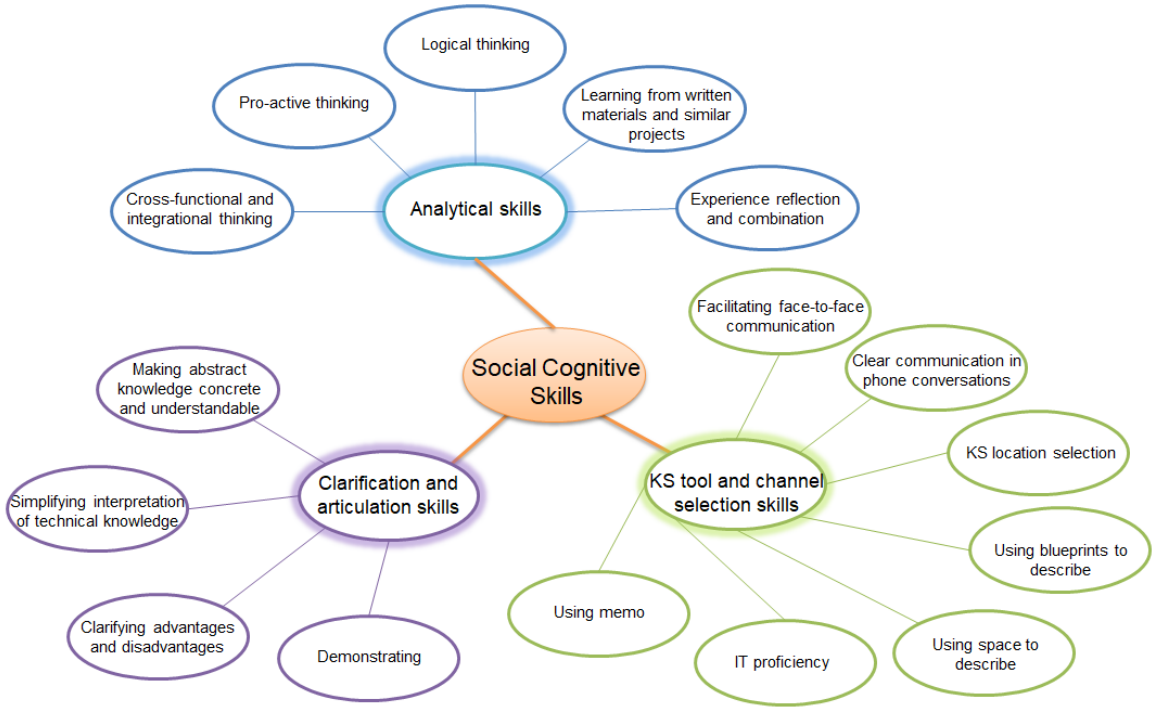


Figure 3.10: Example of concept map

In addition, the text-based manual board, as mentioned in the explicit coding procedure, was continually used to operate constant comparison analysis and visualise the interrelationships between categories and sub-categories. The memos were also used in analysing the relationships between categories as well as sub-categories.

During the analytical procedure, the researcher's attention was quickly drawn to the fact that the categories were pointing in two major directions – knowledge domains that need to be shared and skills contributing to the sharing. Eight main categories emerged from the data analysis, five categories regarding to knowledge domains and three categories regarding to skills that contribute to share the knowledge domains. These will be presented in the Chapter 4 Findings. The dimensions of the categories also indicated that these two specific directions are not isolated but interrelated with each other. Considering 1) the further analysis of the relationships between categories,

2) the indications from categories' dimensions and research data, 3) the need of theory development, the researcher carried out another round of analysis to explore and discuss the specific relationships between knowledge domains and skills, which are presented in the first section of Chapter 5 Discussion.

3.3.3.2 Theoretical saturation and theory development

Theoretical saturation is an important criterion in the adjustment of when to stop collecting data. Practically, it means the data collection methods such as interviews and observations will be continually conducted until a point is reached where no new conceptualisations emerge from the newly added data. Saturation occurs when no new or relevant data seem to emerge or be generated which would further construct the Grounded Theory by developing a category or illustrating important relevant information (Glaser & Strauss, 1967). In this research, theoretical saturation was considered as achieved when 1) no open codes emerged from the data; 2) all concepts and categories were well established with no more chance of generating new concepts or categories; 3) relationships between subcategories and categories, as well as the relationships among categories were well established.

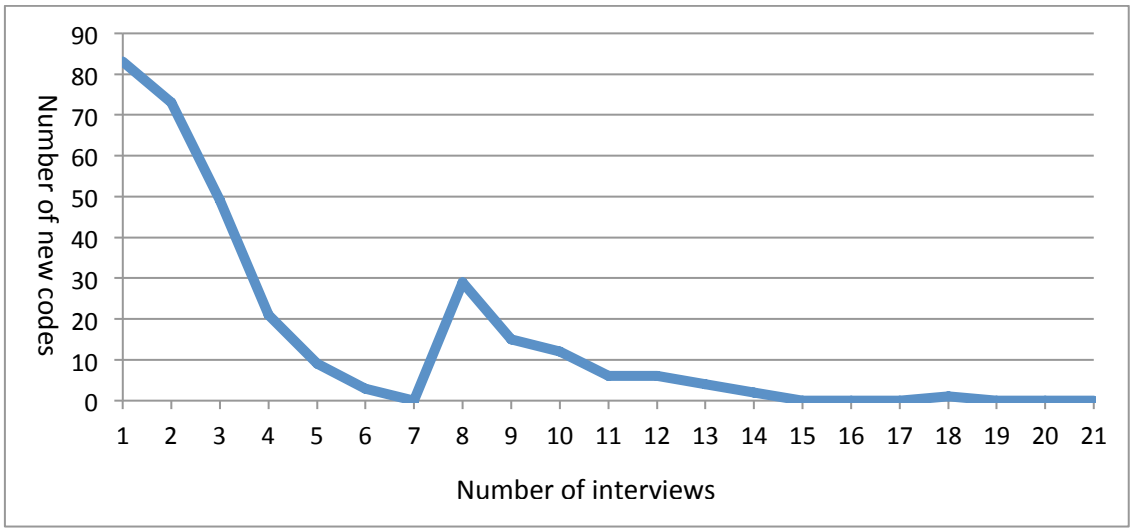


Figure 3.11: Theoretical saturation diagram

The emergence of new open codes and the achievement of theoretical saturation in this research are demonstrated in the above diagram. As shown in Figure 3.11, new codes were continuously emerging in the first set of interviews, and then the number

of codes decreased until the seventh interview. This is because the first seven interviews were conducted with informants from the design institute. According to the theoretical sampling, the researcher was guided to start interviewing project participants form the investing company. A significant number of new codes emerged until the fourteenth interview, after which the data seemed saturated. However, after the seventeenth interview, the researcher started interviewing the informants from the construction company by following the theoretical sampling strategy. A new concept was raised by the project manager from the construction company, and then no new open codes emerged afterwards. The process was continued until the twenty-first interview with the aim of obtaining a better degree of certainty and saturation.

By this stage of the data analysis process, the researcher possessed all the coded data, categories and the underlying relationships. The identification of the three dimensions indicated by the end of the coding procedure, i.e. knowledge domains, skills for knowledge sharing and the relationships between them, integrates the findings whilst constructing a story line describing the results from this study. This leads to the emergence of an integrative framework, which is presented in Chapter 5 Discussion. Firstly, the categories of skills can be strongly related to the categories of knowledge domains, as the skills assist to share the knowledge pertaining to these domains. Secondly, the analysis of the relationships between knowledge domains and skills indicate that certain dimensions of the skills are useful in sharing different knowledge. The theoretical integration is taken forward in the Chapter 5 Discussion, with the aim of positioning the findings and discuss them within the wider body of knowledge.

3.4 Ethical concerns

The discussion of ethical concerns is inevitable in social studies as they involve collecting data from people, especially qualitative studies that may deal with sensitive and personal issues about people's lives (Berg & Lune, 2007). To avoid any conduct that would go against the practice of ethically-sound research, the following steps were undertaken.

To begin with, the researcher applied for research ethics approval in February 2015, and the corresponding documentations and applications were submitted to the Information School's Research Ethics Committee and received approval.

In order to protect the privacy of the case project and ensure the research was conducted with proper ethical considerations, the raw data collected from the case project was only presented to the researcher and her two supervisors. During any further analysis, discussions or presentations, the project's name was replaced by the code name "C Hotel" in order to protect stakeholder's identities.

It is also important to state that participants in this research participated in data collection interviews in a completely voluntary manner. The participants were approached by the researcher in person and were informed of details about the research project, after which they were given enough time to choose whether to attend the interview or not. Each interview was only conducted after receiving consent from participants. In this sense, the interviewees were entirely free to refuse either their whole participation or any specific question during the interviews. Additionally, the participants were kept under anonymity in order to protect their identities.

From the perspective of interview questions, all were designed to not only be engaged with research objectives and theory development, but also with respects to the backgrounds of participants. The interview questions were formulated in accordance to the research objectives but avoided topics related to participants' political, religious and private life preferences or activities.

3.5 Research validity and reliability

The criteria for research validity and reliability are important in both quantitative and qualitative research, but considered differently due to the differences in nature between these two approaches to conducting research. In quantitative studies, where generalisability is the aim, validity addresses whether the researcher explains what he/she claims to be explaining or measuring; reliability examines the methodological appropriateness in terms of the accuracy in processing data (Bryman, 2012).

Qualitative research tends to focus on searching for meaning between the researcher and the informants – for instance, the qualitative nature Grounded Theory methodology focus on searching for meaning in theory building – the criteria for validity and reliability are considered differently from quantitative studies (Lietz, Langer, & Furman, 2006). Researchers have discussed about adapting the criteria and the trustworthiness in qualitative studies. Far back in 1985, Lincoln and Guba suggested alternative criteria for measuring trustworthiness in qualitative studies, containing for factors of credibility, transferability, dependability, and confirmability. More recently, Bryman (2012) proposed the adaption of reliability and validity for qualitative research that qualitative studies are expected to produce in-depth and rich descriptions for the phenomena being studied; as these are context-specific, the level of depth and richness of the description provides the basis for justification. Thomas (2011, p. 71) discussed the research quality from the perspective of case study, and stated that "*the quality of a case study depends less on ideas of sample, validity and reliability and more on the conception, construction and conduct of the study*". This suggests the importance of thoroughness in describing the context and in analysing and drawing conclusions when examining the quality of a study.

Largely consistent with the above approaches, Grounded Theory methodology has its approach in assessing the quality and judging the credibility of a study. Glaser and Strauss (1967) stated that the assessment should be based on the detailed elements embedded in the actual strategies in generating theory, including collecting, coding, analysing and presenting data. The researcher, as the person who analyses the data and develops the theory, should ensure the findings accurately represent data. The theory that emerges from the collection and analysis of data should be indicated in a way that the researcher "*knows systematically about his (/her) own data*" (Glaser & Strauss, 1967, p. 225). In this study, this is largely embedded and reflected in the constant comparison process as presented in Section 3.3.3.1. The data collection and analysis procedures were interrelated and coexisted in this research by following the theoretical sampling and constant comparison strategies, contributing to the systematic understanding and verification of data until the saturation of codes and categories (see Section 3.3.3.2 where theoretical saturation is presented in detail).

Furthermore, regular meetings with the researcher's supervisors during data collection and analysis processes, in terms of discussing interview techniques, reviewing emergent codes and categories, and presenting interpretations, backed and further enhanced the validity, reliability and credibility of the findings.

In addition, with the purpose of theory-building, Grounded Theory methodology considers more of explanatory power, i.e. explaining what is happening in given situations, than generalisability (Strauss & Corbin, 1998). This study is conducted with project participants within a construction project, and the findings are based on the exploration and explanation of what they perceived as important knowledge domains and skills in this particular setting. The linkages between codes and categories developed during the data analysis (see Section 3.3) provide the explanation of the subject and the research context that is being investigated.

3.6 Summary and implication for research

Whilst Chapter 1 introduced the research question and objectives, and Chapter 2 elaborated on the existing body of literature in order to establish an area of contribution and improve both theoretical and contextual sensitivity, this chapter provides a discussion, identification and justification for a suitable research methodology to answer the research question and to operationalise the four research objectives.

The philosophical foundations of the study led to the adoption of an interpretivist epistemology, and an inductive and qualitative research method. Based on the underlying philosophical world-views, various research strategies were discussed with a decision to use Grounded Theory in the context of a case study. The main rationale behind this decision is that Grounded Theory allows the development of a theory, which is the purpose of this study given the lack of research on skills contributing to knowledge sharing for construction project managers; case study provides an appropriate context for this investigation and data collection.

The following section (Section 3.3) described the research design, including an exploration of the theoretical foundation, and the processes of data collection and analysis. A five-star hotel project in Hebei Province, China, was selected for the case

project; a total number of twenty-one interviews were conducted, between July and October 2015, with employees from the three different organisations that participated in the case project. The data was saved in audio files, which were transcribed into word texts for analysis. The ethical concerns and trustworthiness issues about this study were discussed in Sections 3.4 and 3.5.

Following this methodology, the results are presented in two main parts in the following findings chapter, with a further discussion about them presented in the discussion chapter.

Chapter 4: Findings

4.0 Introduction

This chapter presents the findings obtained in this study. It also responds to the first two research objectives as introduced in Chapter 1 Introduction. They are 1) to identify and explore different domains of knowledge that project managers need to share in their practice in the construction industry; 2) to identify and explore different skills that support project managers to share the required knowledge.

Introduction to research findings

Following the sequence of the research objectives, this chapter is divided into two main sections. The first section presents a categorisation of five knowledge domains. This includes knowledge domains of risk, planning, implementation, people, and strategic and operational knowledge for project business. Findings suggest that these five domains are largely aligned with the three phases of the project; furthermore, knowledge pertaining to these domains is of a dynamic and inter-relational nature. The knowledge domains serve as a base to identify and understand different skills that contribute to knowledge sharing, as the skills are required and applied with the aim of sharing knowledge pertaining to these domains.

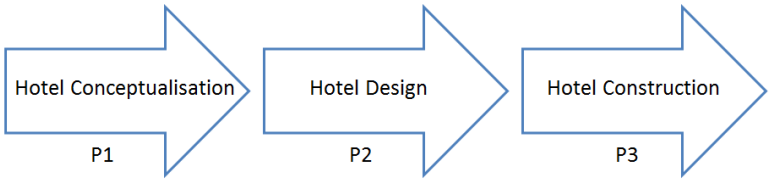
The second section presents the skills that contribute to project managers' knowledge sharing practice. Three sets or categories of skills are identified from the research data: social cognitive skills, interpersonal skills, and strategic orientation skills. Each set of skills is focused on one distinctive perspective in assisting the sharing of knowledge. In addition, their applications differ in 'levels' but are inter-connected.

The findings are then summarised in Section 4.3, which focuses on the dynamic, inter-relational nature of the knowledge domains and the skills.

Contextual introduction

Prior to moving on to the introduction and explanation of findings, it is important to clarify the context of the case project. This study focuses on a typical construction project, the CG Hotel. It is composed of three main phases and engages with the

investing company, the design institute and the construction company. As shown in Figure 4.1, the three phases of this research project include the conceptualisation of ideas, the architectural design of the hotel, and the construction of the hotel. The first phase involves initiating, proposing and conceptualising the concept of the hotel, with the aim of establishing a formal plan. This specifically involves initial project needs identification, general conceptualisation and project scope development. After submission of the plan to and officially approved by the Xingtai Bureau of Construction (one local governmental department responsible for city planning and construction development), the second phase is concerned with executing the design of the hotel architecture as well as its interior and exterior fixtures. Towards the end of this phase, the completed design blueprints require approval by the Xingtai Bureau of Construction. The end result of the second stage is formal architectural blueprints for different functions of the hotel building. The final phase is the construction of the hotel including a construction plan, a specification and physical construction, and completion of the construction with an accordant approval certificate from the government.

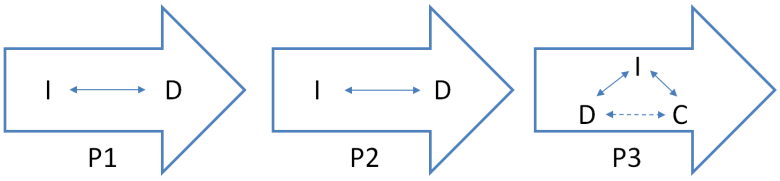


Legend: P: Phase

Figure 4.1: Three main stages of the hotel project

Accordingly, the knowledge sharing practice in the project involves three main stages as indicated in Figure 4.2. During the first phase, knowledge is shared inside the investing company to propose the hotel ideas, and between the investor and the design institute to initiate hotel plans. The second phase involves knowledge sharing between the investing company and the design institute with the aim of designing the architecture of the hotel. In the final phase, knowledge is shared among the investing company, the design institute and the construction company. Throughout the first phase, project managers from the investing company mainly drive the knowledge

sharing. This is due to the purpose of formally conceptualising the project and the fact that the investing company needs to initiate and negotiate their main purposes and requirements. During the second phase, the knowledge sharing practices start to be driven by the design institute, as the main goal is to complete the architectural design of the hotel. Project managers from the design institute need to share their designing-related knowledge to the investing company to formulate agreements. In the hotel construction phase, knowledge is shared amongst all three companies; the investor remains at the core of the knowledge sharing, because they are in the position of guiding and approving the work. According to the research data, most of the knowledge sharing between the design institute and the construction company happens with at least one member from the investment company being present. The knowledge domains and the skills facilitating knowledge sharing are embedded within these three phases.



Legends: P: Phase; I: Investor; D: Design Institute; C: Construction Company

Figure 4.2: Knowledge sharing through three stages of the hotel project

4.1 Knowledge domains

This section addresses the first research aim of discovering the knowledge domains that project managers need to share during a construction project. To answer the research question of what skills contribute to effective knowledge sharing, identifying different knowledge domains is a logical first step as these need to be shared and it is also within them that the skills need to be applied. In this section, the five identified domains of knowledge are presented and discussed.

Table 4.1 provides an overview of the five knowledge domains. For the research aims, the domains that are identified are for the specific role of project manager in terms of

their knowledge that needs to be shared, rather than all project members. Also, the domains were labelled as the knowledge itself instead of an action or property of the knowledge, in order to directly respond to the first aim. Each domain is formulated by a number of sub-domains. The presentation of domains and their sub-domains generally followed a sequential order, largely aligned with which knowledge was shared first in conducting the project. The following subsections provide a detailed explanation of these knowledge domains. Each domain is introduced with its definition and meaning, its relevant sub-domains, its importance and phase of application within the project, as well as the relationships and interactions between them.

Category	Code
Knowledge of risk	Potential risk in design
	Awareness of sequential disturbance
	Hidden threats to the long-term sustainability of the building
Knowledge of planning	Market segmentation
	Understanding of local culture
	Hotel style
	Early concept and requirement of investing
	Balance between appearance and utilisation
	Time frame
Knowledge of implementation	Inter-connectedness of functional areas
	Blueprint fieldwork application
	Emergent investing requirement
	Unplanned design changes
	Requirement and regulation solutions
	Purchasing suggestion
	Collective interpretation of regulations
Knowledge of people	Human resource requirement
	Conflict resolution
	External knowledge sourcing

Strategic and operational knowledge for project business	Organisation self-interests
	Tacit business rules
	Contextual knowledge for the construction industry
	Hotel operational knowledge

Table 4.1: Knowledge Domains

4.1.1 Knowledge of risk

Knowledge of risk refers to the awareness and concern a project manager has about the potential threats that are connected to a decision or linked to a certain context. The risk can be a potential difficulty, challenge or sequential consequence. This knowledge domain is focused on the thinking and prediction from the individual on the basis of mutual contextual understanding, which expands beyond the simple explicit information they produce for risk analysis. It is highly contextual-based and hard to be explicitly codified or written down, especially for the individual thinking process. It is usually shared through face-to-face communication and discussion.

The interviews conducted with participants revealed that sharing knowledge about risk is particularly critical for project quality and time efficiency. The knowledge domain of risk includes three different sub-domains: 1, knowledge of potential risk in the design, 2, knowledge of awareness of sequential disturbance, and 3, knowledge of hidden threats to the long-term sustainability of the building. Each of the sub-domains focuses on one or two different phases of the three-phase composed project. Therefore, in a typical project lifecycle, knowledge of risk is shared throughout all the three stages with varied emphases and perspectives.

Potential risk in design

Knowledge of potential risk in design is defined as the project manager's consideration on how the architectural design can raise potential risks, usually by analysing current work, reflecting on their own work experience and relating these to the design. The concerns for risks are associated in both the second phase of architectural design and the third phase of construction. For the architectural design phase, the design is usually explicitly reflected on the design blueprint. However, the more important issue is to

share and discuss ideas about potential risks during and after designing the blueprint. It goes beyond the boundary of explicit engineering design knowledge and expands towards the project manager's personal thinking and work experience.

> *"Discuss construction plans. Investor PMs and design institute need to share their knowledge and report to (investor) senior managers in terms of main suggestions on the plans and potential influence on construction work in future. … For example, for different electronic line designs, if we feel that from our experience, there might be some difficulties in applying them to actual construction work, such as inappropriate designs or part of the design is difficult for construction people to understand, we would communicate with them." (PMI – I8 – 19-24)*

For the construction phase, the potential risks in design are more related to the usage of the building and involve two-way relationships. Firstly, the practical-orientation of the construction team can result in the identification of potential risks when implementing the blueprint to their construction work. For example, some parts between different functional areas in the blueprint are not connected or cannot be practically conducted in the construction work. This knowledge sub-domain also involves the awareness of influences which different construction plans can potentially cause on construction work as shown in the quotation below.

> *"Sometimes it can be very complicated, as this is a complex project, that in small locations and details one functional area in the design… there can be some problems during construction, because during the design process, some of the designs cannot be well connected or implemented to the construction." (PMI – I8 – 7-9)*

Secondly, when requested to make changes in the design, the design team are concerned with potential systematic risks, because changing an element of the design can result in other corresponding changes, and thus cause potential difficulties or problems. This constitutes another dimension of the knowledge of potential risk in design that needs to be shared.

> *"Our work (architecture) is very technical and complicated. For some required changes, when another functional area requires my functional areas to make*

changes, or come up with something, we need to coordinate and make the changes together." (TMD – I2 – 44-46)

Knowledge of potential risk in design assists in reducing problems in the construction phase. To guarantee project quality and improve time efficiency, it is also important to be aware of and reduce risks from the construction perspective which is discussed in the following knowledge domain – knowledge of awareness of sequential disturbance.

Awareness of sequential disturbance

Awareness of sequential disturbance pertains to project managers' individual awareness, prediction and precaution about hidden issues and consequences that a single action, design procedure, or construction process can cause to others. This is based on understanding the sequential nature of construction work. The sequential nature is one of the major characteristics of construction work, which means if one stage in the construction is not completed properly, or if something goes wrong, the following stages might not be carried out properly, especially in the case of specific procedures that follows in sequence.

"It is always one process after another and if one process doesn't complete, the following one cannot start. For example, if the electrics and pipes cannot be completed, the ceiling cannot be done for the interior fixtures, and that if the air conditioning is not finished, interior fixtures cannot be installed either." (SMI – I13 – 111-113)

Interviews with project managers from the investing company have particularly revealed the importance of sharing sequential disturbance related knowledge. As exemplified by the quotation below, project managers are required to cautiously consider and share this awareness and concerns with team members. This is vital due to the fact that in a construction project, a small issue can escalate and create sequentially larger and even substantial problems, which can lead to re-construction of the corresponding site. Knowledge of awareness of sequential disturbance is important for all three phases of a project, with particular importance during the construction phase. Sharing the awareness of sequential disturbance helps to reduce risks and the possibility of reconstruction.

> *"There are no small issues for interior fixtures. Any small issue can cause a big problem. For example, when a small thing wasn't considered to be installed in the ceiling, later-on after the ceiling is completed we need to reopen it. This is the so-called small issue." (PMI – I5 – 73-75)*

From the perspective of reducing risk, potential risk in design highlights the knowledge from project managers working in the design institute, and knowledge about awareness of sequential disturbance is mainly raised and shared by project managers from the investing and construction companies. The following knowledge sub-domain of hidden threats to the long-term sustainability of the building emphasises the knowledge and concerns from the investing company's project managers.

Hidden threats to the long-term sustainability of the building

This knowledge domain is about the project manager's considerations and concerns regarding how the current construction work can affect the building in terms of its long-term usage and sustainability. Initially, knowledge about long-term sustainability of the building seems to be usability issues of the building; with further analysis, however, the long-term sustainability can represent a risk because inappropriate work can cause problems during building usage. As revealed by the interviewee from the investing company, the risk can be associated with the potential impact of the current construction work on the long-term structural safety of the building.

> *"For example, safety issue for construction work. After all plans get approved and we start construction, there are some places that cannot be done ... (detailed example) ... Another thing is, whether the person is in charge of hotel rooms or the business centre, he needs to apply design changes in work which requires technical measurement and research. But in the end it might not reach construction standard due to safety issues." (PMI – I10 – 76-80)*

The communication and sharing of long-term building sustainability knowledge reveals different perspectives and focuses from the participating companies towards this knowledge sub-domain. Due to the fact that the project is composed of three main organisations, each participant has its own concerns and interests within the project in addition to their common interests. Illustrated by a project manager from the investing company, the investor carries out the role of conceptualising the project and operating

the project after completion; they are more concerned with long-term usage and sustainability. Whereas for the construction company, their goal emphasises more on merely completing the current work and thus pays less attention to the long-term sustainability. This leaves the possibility of generating tensions and conflicts among participating companies within the project. The communication of these concerns and the sharing of potential threats that the building sustainability is confronted with, can help to generate solutions in reducing relevant risks, and therefore helps to reduce potential conflicts between the investing company and the construction company. It also reveals different institutional logics that the skills can potentially harmonise.

> *"The construction worker, his experience refers more to the experience of finishing his work. He cares more about finishing the work rather than what problems can happen later e.g. maintenance issues. For the types of problems that can occur after they have finished the work, I need to notify these issues. These types of problems need to be detected. The construction worker doesn't have the experience to know what problems might happen." (PMI – I15 – 127-130)*

Sharing knowledge about hidden threats to the long-term sustainability of the building is of particular significance for the construction phase of the project. This knowledge sub-domain can be generated from project managers in all three organisations, but is usually more engaged, concerned and shared by the investing company. This is also due to the different perspectives and interests represented by the investing and the construction companies discussed above, i.e. the investing company is concerned about long-term usage of the building after completion while the construction groups are focused on completing the current work.

4.1.2 Knowledge of planning

Knowledge of planning is defined as the consideration and suggestion towards different ideas and solutions before conducting specific work, and the understanding of how to better plan the delivery of the project. Particularly, this knowledge domain emphasises the importance and suggestion of culture, applicable style and market alignment. Beyond the commonly-adopted definition in project management where planning highlights the explicit elements of task, time and team, the presented

knowledge domain in this study has a strong tacit dimension by focusing on the project manager's personal reflection on previous work experience and applicable suggestion on how to conduct the current work. Sharing knowledge pertaining to this domain contributes to effectively scope the project for the suitable market and make efficient use of the investment.

In the typical lifecycle of a project, knowledge of planning is very often shared during the first phase of project conceptualisation, although it is important throughout the project procedures and can also be shared in the other two phases. Revealed by the research data, the sharing planning related knowledge contains six dimensions; these six knowledge sub-domains are inter-connected via a sequential order. The sub-domains of market segmentation, understanding of local culture, and hotel style need to be shared and discussed at the very beginning of the conceptualisation phase, as this decides the direction of design and construction. Afterwards, the sub-domains of early concept and requirement of investing, balance between appearance and utilisation, and time frame are the practical planning knowledge that needs to be shared by project managers.

Market segmentation

Knowledge of market segmentation refers to the individual opinion and concern of the project manager about the needs and characteristics of the project in relation to its market position and target customers. When planning and designing the hotel, project managers and team members need to consider the specific market that the business is being targeted at - in this study the luxurious consumer market. Therefore, when planning for the project, project managers always need to consider this market segmentation and share relevant knowledge especially with regard to the consideration of meeting hotel star standards and the practical usage of the hotel.

The consideration of meeting the star standards refers to the project manager's knowledge and suggestion on how to obtain appropriate rating points for the hotel project. In China, the star level of a hotel is based on a points system; the higher number of points a hotel has, the higher the star level it receives. The case project investigated by this study is a five-star hotel. Knowledge of how the design and

construction can obtain enough points so that the hotel can be rated as five star needs to be shared. In order to meet the criteria of the points system, project managers, especially from the investing company, need to share their suggestion and concerns on how to design and construct the building in a more appropriate way. It is usually not as simple as explicitly calculating the points, but involves decisions such as what criteria should they adopt and which part of the design or construction should they focus their efforts on. Thus, the knowledge being shared is a combination of the project manager's expertise knowledge and their market-oriented thinking.

> *"The five-star hotel relies on the points system: there are some items that can add extra points, and when we reach a certain number of points we can be rated as a five-star hotel. In the beginning we were planning to build a swimming pool on the 4th floor, but then decided the level below the ground floor would be better. We were planning to build a fountain and then decided to do something else instead. We went to visit other hotels and made some changes in our ideas such as the style of air conditioning etc." (TMD – I3 – 88-92)*

Regarding the concern of hotel usage, knowledge about the understanding and application of concepts such as 'comfort' and 'luxury' need to be regularly shared by the project manager. This is because the requirements of the luxurious market sector can go beyond that of simply meeting design and construction standards. Despite the tacit dimension of this knowledge domain, the shared knowledge is always reflected on relevant explicit and specific issues. For example, reminding the designer that it is more important to minimize the toilet flush noise than to save water, and acknowledging where to allocate the closet inside the customer room.

> *"Hotel needs to be very comfortable. Why is it comfortable? Because it is there. Many people around the world are studying how to make it comfortable. For example, the door has a thickness measurement, the toilet needs to be low noise rather than water saving. The hotel itself is a place of high consumption; it has high requirements compared to our daily life accommodations. We need to share and remind these concepts with others." (PMI – I11 – 301-304)*

Knowledge of market segmentation is one of the sub-domains that project managers need to share at the first stage of conceptualisation within the project, in order to decide which segment of the market the hotel should be aimed at. In addition to better address market segmentation, this knowledge sub-domain can also be shared in the second and third phases of the project, but with emphasis on its implications in design and construction. Sequential to market segmentation decisions, knowledge about understanding local culture is another important planning issue in terms of how to reflect local culture in the hotel design and construction; as discovered from the interviews, the five-star hotel needs to be designed in reflection of local culture – this is discussed in the following sub-section.

Understanding of local culture

Understanding of local culture constitutes an important part of planning knowledge that project managers need to share. The local culture mostly refers to the regional culture of Xingtai City, including its history and the commonly known folk tales about the city. The understanding of local culture in this study refers to the project manager knowing the local culture, and combining, representing and applying the culture to the construction project. It can be reflected through the architectural design, the construction, and the interior and exterior fixtures of the hotel.

> *"Then we need to discuss whether to adopt the culture of our company or the culture of local region or city. The regional culture needs to be reflected in many ways. This is quite a big idea. After deciding, I need to share with team members and the construction teams. Then we will figure out how to exactly apply these things." (SMI – I13 – 78-80)*

Knowledge pertaining to this sub-domain is mostly shared in the planning phase of a project lifecycle, specifically when the project managers from the investing company and the design institute discuss the generic plan of the design. It is important for project managers from these two organisations to share their understanding of local culture and reach an agreement at the beginning of the project; the adoption and reflection of different perspectives on culture can directly influence the architectural design as well as that of interior and exterior fixtures. There are different reflections of local culture; for example, Xingtai City has a long history with a number of rivers, and

thus people use 'well' to describe both water and wealth. The design of interior and exterior fixtures can adopt the 'well' culture and it can also be reflected in the designs of walls and carpets.

> *"Xingtai city is the most historical city in Hebei province. For example, the culture of the 'well' character includes the idea that well means water, and water brings fortune. We need to share and discuss the culture issues in our planning." (PMI – I11 – 55-56)*

The sharing of local culture also includes organisational culture. Despite the fact that local culture and organisational culture are usually considered as very different issues in organisational studies, the focus here is how to represent and apply the culture in the construction design. When sharing knowledge about planning management and on how to culturally design the building, the reflections of local culture and organisational culture are both important.

> *"We have designers in charge of interior fixtures. The first thing we discuss is regional culture. High star hotels need to reflect a local culture, unlike the lower starred hotels that can design without culture issues involved. The high star hotel must have culture. Our hotel in Xingtai City is considered as a high level place, so it needs to contain Xingtai culture. Xingtai culture is Taihang culture, and taihang culture reflects Xingtai culture." (PMI – I11 – 50-53)*

As revealed by the quotation above, it is the responsibility of project managers to share and discuss their understanding of the culture, particularly those from the design institute. The decision on how to reflect local culture will be adopted and applied in both the design phase and the construction phase.

Hotel style

Knowledge of hotel style is another crucial sub-domain that needs to be considered and shared at the same phase as the understanding of local culture. It refers to the project manager's opinion and suggestion on what style the hotel should be, and after reaching an agreement, how the style can be applied in the architectural design and in conducting interior and exterior fixtures work. For example, project managers need to share and discuss ideas of either adopting a western style or traditional Chinese style,

applying a more luxurious or business appearance and whether dark or light colours should be used as the main theme.

> *"I would share with them in terms of styles, such as what style the accommodation rooms should be. ... What is the main feeling and style, whether the colour should be light or dark, whether the style is simple Chinese style or something else." (SMI – I13 – 70-73)*

Hotel style related knowledge is mainly shared between the investing company and the design institute in discussing the design styles. It is also shared among project managers and their senior manager in the investing company. In particular, when reporting and discussing with the senior manager, project managers need to share different styles together with personal perspectives on each architectural design plan. They also need to report about the negotiation process with other participating organisations when necessary. This is with the aim of reaching an agreement inside the investing company for decision-making.

> *"After discussions, we decided the type of our hotel is business type, so it is designed as this type. The hotel must have a type, as the type decides on how to arrange the rooms and space, how many meeting rooms we need, how many places for dining, etc. So, the hotel first needs to have a target position and type. After that the designer can start his design work." (PMI – I11 – 68-71)*

Similar to the sub-domains of market segmentation and understanding of local culture, sharing hotel style related knowledge can also significantly affect the project design and construction. Besides, knowledge of hotel style has causal relationships to the knowledge of market segmentation and understanding of local culture. The market segmentation and cultural reflection, to some extent, directly affect the discussion on hotel styles. In return, the style negotiation can reflect the sharing of market segmentation and local culture, and decide whether the target market and culture objectives are reached. Sub-sequential to sharing these three sub-domains, the sharing of more practical-oriented planning knowledge takes place as presented below.

Early concept and requirement of investing

In the first phase of the project, project managers from the investing company need to outline their initial project ideas and requirements and share these with the design institute. Then, the design project manager needs to integrate these requirements and share their feedback with the investor. An important knowledge component involved in the process is the early concept and requirement of investing, i.e. the identification of project concepts and design requirements from the investing company and the integration of all the identified requirements in order to conceptualise the project and formulate an initial project plan. The processes of identification and integration also play a role in the negotiations towards investing requirements.

During these processes, the shared items are not merely the formalised criteria and feedback, but more importantly the thinking behind each decision. The knowledge that needs to be shared includes the reasoning behind why a requirement is needed, and discussing whether the requirement is accepted and how to modify the requirement if it cannot be fulfilled. For example, by sharing how the requirements were formulated from the investing project manager to the design institute, the concept of the project can be better understood by the designers. Similarly, when explaining the feedbacks – especially that which involves some requirements that need to be rejected – project managers from the design institute need to explain how feasible and difficult the design work can be. The sharing of such thinking and concerns are very important, as it helps the participating companies to better understand each other in terms of their positions within the project and decision making.

> *"The beginning is very important. Beginning I mean the plan for architecture and blueprints, in other words to decide which plan to take, the style and type of the building, designing requirements for architecture etc. These are all important. … This is the architectural plan. Based on the investor's requirements, especially their senior manager's opinions, we decide together whether the plan is feasible. If it's not feasible, we need to propose more reasonable solutions and plans; then the design institute works on modifying or redesigning a new plan." (PMD – I1 – 133-137)*

Sharing the knowledge of early concept and requirement of investing is very important for planning, as it directly affects how the design and construction should be planned and serves as a driver in conceptualising the project. This knowledge is generated and used at the first phase of the project before submitting the project plan to the Xingtai Bureau of Construction. It is mostly shared among project managers from the investor (and sometimes with the senior manager), among project managers from the design institute (and sometimes with the chief engineer), as well as between the investor company and the design institute. Moreover, the discussion and sharing can help the senior manager from the investing company make more informed decisions.

Balance between appearance and utilisation

Knowledge of balance between appearance and utilisation refers to the individual opinions and collective discussions on how to balance the building's utilisation and appearance within budget limits. The three participating organisations consider utilisation to be very important. However, the appearance is also considered to be important by the investing company and sometimes they place more importance on this than utilisation, because some project managers think the first impression of the hotel can affect consumer choice and the positioning of the hotel. Therefore, it is vital to reach a balance and agreement on the appearance and utilisation among project members; this knowledge sub-domain is shared inside the investing company and between the investor and the designer.

> *"The investor may see appearance or beauty as the priority. Economy, aesthetics, usage and safety are the four principles for design. Safety is important for everybody; then among economy and beauty and usage, the investor has its options and priorities. In some cases the investor can give up some space to create a stylish design – he spends money for beauty. This is very possible. As designer I need to let the investor have their preferences and priorities. If they give priority to beauty rather than economy or usage, we design people cannot point out that it is wrong. Design itself can be an art. (PMD – I6 – 161-166)"*

A balance is usually reached via discussions between the project managers of the investing company and the design institute. The main reason for the need of

discussions is to address their different priorities and preferences. The investing company places more importance on the economy and appearance of the hotel building and are willing to give away some utilisations in order to make the hotel look luxurious and beautiful. The design institute however, invests a lot of effort on safety and utilisation of the building. Thus, these two participants need to reach an agreement that fulfil both of their requirements.

> *"It's mainly from the design of plans. For example, they plan to build an underground car park. The arrangement was big at that time. … So after calculation we know that the cost can be high. We discussed with the investor whether we can change three cars per individual place to two cars, so that it can save some investment." (CED – I4 – 9-14)*

Sharing both the knowledge sub-domain of early concept and requirement of investing and this sub-domain of balance between appearance and utilisation can assist the project manager in managing and spending the investment in an effective way. In particular, the design project managers need to understand the investor's preferences and priorities in terms of requirements and then seek a balanced way of managing this in order to achieve a desired design that is within budget. To do this, another knowledge sub-domain they also need to consider is regarding to time frame.

Time frame

Knowledge of time frame refers to the considerations on the amount of working time needed in order to complete the task, including the need of extra working time when changes are required. The sharing is focused on the negotiations of different working groups in terms of their working speed and processes, in order to better coordinate and align them with appropriate tasks and working time. For the three-year hotel project in this study, the timeline is divided into many specific time-frames with deadlines. As the main drivers and coordinators of the project, project managers from the investing company need to negotiate the time frames with relevant working partners and reach agreements on expectations.

> *"Usually, as a hotel, there is not too much working load for the structure area... But for facility areas, it can be complicated. In this situation, the project time limit cannot be set according to the structure functioning area; it needs to be*

according to facilities areas. For a specific project our manager usually needs to analyse and then sets the time length for each of us." (TMD – I3 – 71-75)

The time frame within a construction project is usually fixed and explicit, involving concrete engineering and operational information such as which group should complete which construction task. However, the process of time frame negotiation exceeds beyond this and involves sharing tacit knowledge including the reasoning as to why the time frame is set in such a way and arranging how to control and coordinate the time for each group. Examples include: 1) certain functional areas within the design require more consideration than others and thus need a longer time to complete and 2) extra construction work needs to be carried out in order to complete the task, which can exceed the time length that was previously agreed. This type of tacit knowledge is usually gained through the project manager's work experience and needs to be shared with others. The main principle here, is to minimise disruptions and conflicts among different groups, and guarantee the best working efficiency.

"We need to coordinate the time, such as after construction work A, work B enters the field; B entering the field doesn't affect other construction works etc. This is the biggest principle. … It belongs to the changes; sometimes there are changes in the blueprint which requires coordination between different companies… According to the blueprint, estimate how many days are needed to complete. If there are more changes, more work will be required and thus more days would be added. Usually it's about the amount of days and fees." (PMC – I18 – 77-86)

Knowledge of time frame is linked to and involves the knowledge of organisation self-interests, which is under the category of strategic and operational knowledge for project business in Section 4.1.5. Negotiating on time frame between different organisations is a way to share and communicate about organisational self-interests, and also helps project manages to reflect on the interests within their own organisation. This will be further discussed in Section 4.1.5.

4.1.3 Knowledge of implementation

Implementation knowledge in this study relates to the 'how-to-do' knowledge in order to solve problems that occur during the architectural design and construction, usually

associated with the project manager's work experience and lessons learned in the past. It is not merely technical engineering knowledge regarding calculations and formulations. Despite that the construction work requires explicit and technical engineering knowledge as its foundation, many important tacit dimensions of implementation knowledge such as suggestions for construction changes and purchasing suggestions need to be shared by the project manager.

Knowledge of implementation is mostly shared in the design and construction phases of the project, as these two phases are associated with implementing the architectural design and construction work. This knowledge domain consists of seven different sub-domains; the introduction and presentation for each of these follows a sequential order in terms of which knowledge needs to be shared prior to the sharing of other knowledge. Knowledge of inter-connectedness of functional areas is important for the architecture design of the building. The sub-domains of blueprint fieldwork application, emergent investing requirement, unplanned design changes, and requirement and regulation solutions applied in both the second and third phases of the project. Knowledge of purchasing suggestion is useful and shared during the construction phase of the project. The collective interpretation of regulations knowledge is shared throughout the project.

Inter-connectedness of functional areas

The 'inter-connectedness' refers to the relations among different functional areas of a construction project and the influence of one functional area on others. Knowledge of inter-connectedness of functional areas is defined as the understanding of functional areas that occur across the knowledge boundary of one's own responsible domain. Therefore, in practice, project managers not only need to consider their own area of expertise, but also how this area can affect other functional parts and share this accordingly with the relevant members.

Knowledge in this sub-domain has two dimensions. Firstly, it refers to the project manager's understanding of what knowledge in his own functional area is critical and fundamental that requires people working on other areas to also understand in conducting the project task. This 'critical and fundamental' knowledge needs to be

expressed and shared with project members from other functional areas. For instance, when there is a change in requirements from the investor, the structural project manager from the design institute needs to make team members aware of the influences and impacts resulting from changing structure design to other areas. This is exemplified by an interview with a project manager at the design institute; when a specific tube for water circulation was required, this needed to be shared and coordinated with members in charge of architecture and structure so that a consistent approach is adopted.

> *"The five functional areas need coordination and agreement. For example, in facilities, the tube for water circulation needs to be discussed with the architecture area in terms of whether it is suitable to place the tube there, whether it would affect the usage. It also needs to be discussed with the structure area in terms of any structure issues with the tube. This is a process requiring knowledge sharing and communication, also integration and agreement. If they only design their own area without communication with others, later these areas cannot be integrated into a comprehensive one. This can cause problems." (PMD – I1 – 37-42)*

The second dimension refers to knowledge on how to properly integrate all the different functional areas without any confliction between them. This needs to be shared during the architectural design phase and the construction phase of the project and involves integrational discussion and proposal of solutions. For example, when different construction groups work together and come across problems such as time and resource conflict, the relevant project manager needs to share individual understanding towards the inter-connectedness of these functional areas and the influence that one construction functional area has on others. The team then needs to formulate a comprehensive solution. During this process, the importance of the integration of different functional areas should be recognised by project managers and be shared with others when necessary.

> *"Different functioning areas need to communicate almost all the time. For example, I have some changes, no matter whether they are technical, usage or changes from the investor, I need to let other functional areas be aware of it,*

and check if it would affect them. They need to change accordingly if their area is affected. This can happen all the time." (PMD – I1 – 147-150)

Knowledge of inter-connectedness of functional areas is particularly important for project managers from the design institute as they are the 'experts' in translating and interpreting investor's requirements into design solutions; the design work often involves the cross-boundary knowledge of different functional areas. Thus, development in understanding the inter-connectedness and sharing of this knowledge domain usually takes place in the second phase of architectural design and the third phase of construction work.

Blueprint fieldwork application

Knowledge of blueprint fieldwork application refers to the concerns and doubts surrounding construction blueprint when applying it to the construction fieldwork. As stated in the introduction section of this chapter, the construction blueprint is the result of the architectural design phase, and before starting the third phase of construction the blueprint needs to be officially approved by the government. For this reason, the blueprint usually does not contain obvious mistakes, and thus the focus of this knowledge sub-domain is not about checking or matching the blueprint against the construction field. Instead, it looks at the areas where the design of blueprint theoretically works well but lacks practical consideration, which can introduce hurdles to the construction fieldwork.

"For many issues, although you consider many angles and think there shouldn't be problems in principle, problems do occur at construction field. For some places, when it comes to blueprint, the blueprint actually needs to be designed according to construction field. Some of the designs are based on personal imagination or deduction, but it cannot be applied at a real site. Then it has to be changed." (PMI – I8 – 117-121)

Knowledge of blueprint fieldwork application is usually shared due to the practical orientation of project managers. Project managers – especially from the construction company – can re-consider whether the design of the blueprint takes into account all aspects of the construction work, such as whether the design is convenient for construction workers and whether the design will create some construction issues that

could be avoided at the design stage. When any inconvenience or improper design matters are detected, these are shared with other project members. It is mostly shared in the construction phase of the project as it focuses on and solves potential construction problems.

> *"The designers nowadays like making design prints luxurious and attractive, but they are not easy to use or apply. As a result, the design blueprints cannot be applied in the construction work. It's of course easy to draw the design, either by hand or with a computer, and they can be innovative with their designs both in terms of shapes and features. But in construction work, it's not applicable. Construction is by hand, or some parts are made by machine but 80% are by hand. It's practical. The practical application is more important than theory." (PMI I15 – 256-261)*

As exemplified by the interviewee quoted above, one cause of the necessity in sharing this knowledge is the different expertise backgrounds and standing points between the design institute and the construction company. Specifically, the design institute is focused on the theoretical measurements and issues while the construction groups are very practical oriented. As a result, some design work cannot be practically applied in the construction. Therefore, knowledge of blueprint fieldwork application needs to be shared between the design and construction project managers.

> *"Another thing for the construction blueprint, some designs of structure or facilities are not detailed enough. By 'detailed', I mean, to consider comprehensively. It was designed in one way, but the design actually didn't consider all aspects and can create some inconvenience in the construction and hotel usage stage. For example, inappropriate design of the window size can make interior fixture difficult." (PMD – I1 – 139-142)*

This sub-domain varies from the sub-domain of potential risk in design (see Section 4.1.1). The main differences are their focuses and main phases of sharing. Blueprint fieldwork application knowledge is shared during construction phase after the blueprint is officially approved, and focuses on very specific issues in blueprint based on the construction context. Knowledge of potential risk in design is mainly shared in

the second phase, and focuses on what potential problems the design can cause on the basis of the practical orientation and assumptions from project managers.

Emergent investing requirements

In the architectural design phases, the investor can propose modifications and changes related to requirements while the design work is being undertaken. In order to understand and implement these requirements adequately, project managers from the design institute need to estimate the proposed requirements from multiple perspectives, such as difficulty level and time needed in order to complete the changes. During this process, emergent investing requirements and reasons for requiring changes are shared from the investing project manager to the design institute. This happens when the investing company partially changes their original ideas in terms of the plan or discovers better solutions towards their initial thinking. Another type of emergent requirements relates to the investor's concerns about whether the design choices would affect the expected design appearance of the building. Therefore, before the actual construction work starts, the investor reconsiders the design choices and its influence on the building appearance, and ponders whether any further changes are needed. The reasons behind this are that the project manager from the investor's side pursues more the sense of luxury and a polished design, and blames the design institute for being too conservative rather than innovative. Project managers from the design institute however, are more concerned about practical and safety issues. These perspectives that emerge from the different stances need to be shared between the investing company and the design institute.

> *"As I said, it (what design institute proposed) saves brain-thinking. They just want to put an upright column there, not considering anything about appearance or effect. …The basis is not to affect the building appearance, which in other words is to, trying to keep the original look. If we have to change, we need to call the design people and construction project managers, together with us (from the investing company). We have to remind them not to affect the appearance of the building."(PMI – I11 – 137-138 and 226-229)*

As well as in the design phase of the project, emergent investing requirements related knowledge is also shared in the construction phase of the project. In the construction

phase, the requirements have already been agreed among the three participating companies before the construction work starts. However, when the investor has some additional requirements or some changes from the original ideas during the construction stage, they need to communicate the requirements. A typical situation is that the blueprint was completed and construction begins, but the investing company insists on making changes for better business operation purposes. Thus, they need to discuss the requirements, and project managers from the design and construction companies need to reflect their experience of the field work, in order to determine whether the requirement is feasible.

> *"Both technical and management. In management, it involves construction sequences, speed of production, etc. In technical perspectives, it contains construction blueprint and techniques in producing. … When deciding time length, we usually accord to the level of difficulties. As we did many projects previously, we have our knowledge and estimations." (PMC – I18 – 6-11)*

Emergent investing requirements and the knowledge sub-domain of early concept and requirement of investing (see Section 4.1.2) are focused on fulfilling the requirements from the investing company. The difference is that knowledge of emergent investing requirements is shared throughout the second and third phase of the project, and impacts some specific and detailed parts of the project. However, the discussion and negotiation on early concept and investing requirement is mostly shared during the architectural plan phase before the design work starts, which is always related to the project manager's knowledge of cross-functional areas and work experience. The decision from the early requirements negotiation can affect the sequential phases of design and construction.

Unplanned design changes

Knowledge about unplanned design changes has a sequential and casual relation with the above sub-domain: after sharing emergent investing requirements, the unplanned design change is the sequential knowledge that needs to be shared. The emergent investing requirement related knowledge is shared driven by the investing project managers, while knowledge about unplanned design changes is driven by the design project managers to facilitate discussion and sharing.

Unplanned design changes refer to the considerations and the needs for architectural design changes, which are not scheduled in the original plan. The knowledge to be shared includes how necessary the unplanned changes are, how to fulfil the investing company's requirements and opinions towards the priority and sequence (e.g. which functional area should make changes first before others) of different changes. As the participant contracted and paid by the investor, it is the design institute's responsibility to accommodate these changing requirements in a reasonable and applicable way. This requires considerations regarding feasibility and time management; this knowledge usually involves the project manager's previous work experience.

> *"Sometimes our design contains some small mistakes or problems and we will make some changes to them. For example, when the construction work cannot be continued due to construction height or pre-reserved space, or when there are some issues that are not applicable to the construction field, we would be asked by the manager to quickly draw the changes on the blueprint. We make these changes on the blueprint that we originally designed." (TMD – I3 – 28-32)*

Knowledge of unplanned design changes can also be shared and driven by construction project managers in the third phase of the project, when some problems are detected after the completion of the architectural design, particularly when the blueprint is revealed to have applicable influence on the construction fieldwork. In this situation, the knowledge is shared from the construction project manager to the design and investing project managers, focusing on the necessity of making partial blueprint design changes, with the aim of convenient construction work.

> *"During construction stage, the investor may have some changes or some new ideas because the construction time is long. As it's a hotel, I may have some changes on concepts and ideas. … Easy to start but hard to construct. There is always change in interior and exterior fixture, even for a home (let alone the hotel). Different leaders have their own opinions, and when they are not happy with it, they ask you to redo the work." (PM – I13 – 86-91)*

Requirement and regulation solutions

In accommodating design changes, another sub-domain of knowledge that needs to be shared is requirement and regulation solutions. It refers to the collective negotiation of

possible solutions or alternatives between achieving the investor's requirements and conforming to design and construction regulations, which usually involves compromising some requirements in order to fulfil relevant regulations. The knowledge being shared includes seeking compromise between requirements and regulations, looking for alternative ways of doing things, meeting overall requirements and achieving project goals.

> *"We cannot make changes if the requirements from the investor do not meet regulations or standards. But sometimes if it cannot be changed straight away, there can be alternative ways to fulfil his requirements especially for the space arrangement. …. The investor might not know too much that they only consider usage. But maybe we can adjust somewhere else to fulfil his requirements and at the same time meet regulation standards." (CED – I4 – 69-75)*

Knowledge of requirement and regulation solutions is usually shared when the requirements from the investing company cannot be directly implemented due to regulation concerns. To address this, project managers from the design institute or construction company can provide alternative methods in achieving similar requirements. They can also seek a compromising solution that decreases the level of requirements but still guarantees the regulation criteria are met. For example, the investor raises a certain requirement with the project managers from the design institute, but the requirement cannot be directly met as it conflicts with the regulations. In this case, the design project manager can propose some modifications to that requirement which can meet the regulation standards while maintaining the main purpose of the requirement. This knowledge sub-domain involves the project manager's self-reflection on the design and construction regulations and application of these within the project work.

> *"Some of them cannot even meet fire control standards. It cannot be changed… It's just that they think it's very appropriate, but they do not consider regulations, or maybe they don't have this knowledge. These are the times when our manager communicates with them, she needs to give them feedbacks based on vivid examples from previous experience. " (TMD – I5 – 329-331)*

A different, yet related situation occurs when the investor's requirement is totally non-applicable even after negotiations and changes. In this circumstance, the knowledge that needs to be shared from the design or construction project manager is the explanation of why the requirements cannot be implemented.

Purchasing suggestion

Knowledge of purchasing suggestion pertains to individual opinions and relevant experience towards the items to be purchased. During the construction work, for instance, the project manager needs to suggest what types of products and items to purchase, i.e. what requirements, principles and standards should the company set in terms of the product's quality and economic cost. It is usually discussed between the project manager and the senior manager from the investing company, with the aim of maximising the quality of purchasing materials as well as the quality of whole project within the financial budget.

> *"For example, for the hotel rooms at the beginning stage of interior fixture, we had many discussions about what facilities and items to purchase, and whether it meets the standards and requirements." (PMI – I9 – 98-99)*

The discussion on purchasing usually starts with specific items and formal stipulation. When the conversation reaches the situation where several products all meet the criteria, this can trigger story-telling and experience reflection from project managers. They can provide suggestions on which product to purchase based on their individual experience from other projects. From this perspective, the sharing assists senior managers in decision making.

> *"Sometimes the construction teams want to save money so they would purchase something cheaper to replace the required materials. At this moment you need to talk to them to say 'no' and insist on your principle. For example the leather they purchase can be artificial leather rather than real leather. Then we would explain to them our interests and make it clear that we only use the same quality of product as we require. If you don't purchase the same ones, we would purchase them ourselves." (PMI – I11 – 257-261)*

Knowledge of purchasing suggestion is mostly shared in the construction phase of the project as this phase involves purchasing different materials for the project. The sharing can also involve explaining different interests of project participants. For example, the construction company can seek to make savings on materials, while the investing company attaches more importance on product quality as this can affect the operation afterwards. When there are different preferences in purchasing, project managers need to exchange their reasons and standing points. The explanation of interests of own company will be further discussed in Section 4.1.5 under the category of strategic and operational knowledge for project business.

Collective interpretation of regulations

Collective interpretation of regulations refers to the collective understanding and joint interpretation of the design and construction related regulation items, and their application to current work. Despite the fact that the regulation items are fixed and explicitly-written pieces of information, people can have different interpretations on how to apply them to the work and there is more than one implementation method that meets the regulatory criteria. The understanding of the generic regulatory environment and various interpretations in reaching an agreement are the tacit knowledge that project managers need to share in order to reach a final agreement.

This knowledge sub-domain highlights that there is flexibility in both the understanding and application of the regulations. For example, the rules and regulations place restriction on the design but the requirements of the investing company still need to be met. Different designers will have different views, ideas and solutions as to how to achieve these requirements whilst meeting the rules and regulations. Thus, project managers need to share their understanding of relevant regulations and encourage team members to share different interpretations.

> *"Considering from my perspective of the structure functional area, it's very often about the understandings towards regulations. Myself and our chief engineer sometimes have different understandings about items in the regulations, and we would have hesitations. Sometimes we even have some arguments, but in the end one person always persuades another. For some*

project examples/ cases and regulations, we can have different understandings." (PMD – I1 – 191-193)

Another typical situation requiring the sharing of regulation interpretations is that team members (especially architectural design members) sometimes are not able to fully understand the regulatory items. This needs the project manager to further explain and discuss with the members in terms of what the regulatory items actually mean and how they can be applied. The knowledge shared is based on both explicit regulatory items and mutual understanding of the application context, usually involving detailed discussions on what the written-items really mean and reflections on the project manager's own understanding.

"There are items from the regulation. In the end it must be one able to persuade the other, but it is based on the regulation items. It's all about understanding, i.e. whether your understanding is correct and comprehensive enough. … Inside each functioning area it can be different techniques or understandings. Some people think it's safe to do so while others think it's not safe to design in that way. Designer can have disagreements with chief engineers." (CED – I4 – 123-127)

The aims for sharing the collective interpretation of regulation knowledge are to reach agreements among different perspectives from team members and project managers and to apply the best solution that serves the project objective while following the regulatory rules. This sub-domain is shared throughout three phases of the project, particularly in the second and third phases. The design work can generate different perspectives on applying regulations into the design, and thus provokes discussion over regulation and the approach of collective interpretation.

4.1.4 Knowledge of people

Knowledge of people has two dimensions: the knowledge of how to work more efficiently with the project members and the knowledge of consulting experts externally. Specifically, it refers to the project manager's understanding of the strengths and weaknesses of the employees and bidding construction groups when appointing them to appropriate positions for the project. Knowledge of people also involves knowing experts in the field through social relations and knowing who can be

consulted if any problems occur during the project. It is an important knowledge domain that needs to be shared as this knowledge can affect the outcome of the project from perspectives such as teamwork and coordination.

Human resource requirement

Knowledge of human resource requirement refers to the project manager's considerations and reasons for allocating intra-organisational employees to appropriate positions and for outsourcing to appropriate teams to work on the project. Accordingly, this sub-domain is shared in two types of situations. Firstly, for each participating organisation, project managers need to share their knowledge of intra-organisational human resources selection. At the start of the project, an essential task is to choose and allocate employees from the organisation to the project. Project managers need to share their opinions and suggestions in terms of which employee or which group is suitable for a particular position. It is shared between project managers and organisational senior managers in charge of the project.

Knowledge of human resource requirement places an emphasis on knowing employees and having an understanding of what characteristics (experience, motivation and personality) a specific position requires. It also involves knowledge about how to build a team by taking into account individuals strengths and weaknesses and how they can work together to support each other, as well as aligning the group strategically with project goals. For example, for a five-star hotel project, a team of all experienced members from the design institute is appropriate. While for some easier residential projects, the design project manager would choose a team with both experienced workers and young workers who are efficient and quick to learn, for the purposes of guaranteeing the quality of the team and developing new member's abilities. All these considerations need to be shared with the senior manager and other project managers inside the organisation for decision making.

> *"In our team, the members have different levels in terms of work. There are generally two types of members: those who are good at difficult and challenging work and those who are skilful and quick, but not good at challenges. So in my work, I would arrange team members according to the characteristics of the*

project and role. If the project is not very difficult and requires a lot of repeating, I might arrange those high efficiency team members." (PMD – I6 – 50-54)

Secondly, human resource requirement knowledge is also shared at the beginning of the third phase of the project when the construction company and the investing organisation select construction teams. For the hotel project in this study, some of the detailed construction work was outsourced to different external construction teams. The outsourcing opinions should be discussed and a joint decision should be made by the investing and construction companies. During the selection process, the knowledge being shared is not only the project manager's evaluations of different construction groups, but also reasons and explanations for why the evaluation and decisions were conducted in such ways.

"Big hotels often require high qualifications when selecting construction groups. Each construction team is officially measured by the government and receives relevant qualifications. We usually require Level 1 qualification (which is at the top of the qualification levels) teams. But in order to save our cost and also guarantee the quality of the project, what we did was to use the Level 1 qualification construction team to participate in some crucial processes while recruiting Level 2 teams to conduct the detailed construction… This is to save some investment." (PMI – I11 – 31-36)

In China, as mentioned in the quotation above, construction teams are evaluated and given different levels of a national qualification (levels range from 1 to 3, with 1 being the highest). The process of selecting construction teams involves identifying a mix of level 1 workers for some crucial and difficult tasks such as architectural and structural construction, and level 2 workers for other types of work, such as detailed construction inside a space. This is based on the consideration of both the quality of the construction groups and the economic costs. Relevant knowledge on this process needs to be shared inside both the investing and construction companies, and between the two.

Conflict resolution

Knowledge of conflict resolution is mainly used to address issues with coordinating project members and resolving conflicts inside the project. It refers to the project

manager's understanding and proposed solutions to minimise the conflicts that occur during the project, usually involving coordination among project members and between project groups.

> *"First it's about our attitude. We need to respect the investing company, even when we put a lot of efforts to design and they still require different changes. But as project manager myself, I need to understand the investing company's concern and then share these with my team members. So they can understand the investors as well, and more willing to conduct the work." (CED – I4 – 113-115)*

As described by the interviewee below, to solve a conflict, the project manager always needs to engage with and combine personal arguments together with facts such as working time, requirements, and individual and group situations.

> *"It is always one process after another and if one process doesn't complete, the following one cannot start. For example, if the facilities cannot be completed, the ceiling cannot be done for interior fixture, and that if the air conditioning is not finished, interior fixture cannot be installed either. In these cases we need to coordinate. Each construction work needs to have an approximate time length for completion. Sometimes the PMs coordinate themselves, or I (senior manager) can cooperate. Sometimes when PMs coordinate themselves they might have conflicts; if we ask the construction teams it can be troublesome too. This is for the main purpose of speeding up the construction processes." (SMI – I13 – 111-117)*

The sharing of conflict resolution knowledge occurs throughout the project, especially during the construction phase. During this phase, different construction groups are sometimes required to work on different parts of the construction building at the same time, but there are also cases where two groups can be working at the same place or using the same resources. This is when conflicts between groups can occur, especially when they are under time pressure and want to complete their own work. It is essential for the project manager to communicate with each group about their experience and knowledge in order to solve the conflicts.

External knowledge outsourcing

In addition to knowledge about members inside the project, knowledge of people also includes the dimension of knowing external individuals, especially through social relations. External knowledge outsourcing pertains to the project manager's knowledge about different experts outside the project for the purpose of future consulting, i.e. the knowledge of directing the knowledge receiver to a relevant expert for further consultation. It is about linking the project's internal networks with external sources of information and knowledge, which sometimes involves cooperation with external partners.

> *"There are some issues in the project that I have not dealt with before and don't know how to. The project manager knows more than me, and she would state that there was previously a similar project and I can ask the relevant person who was involved with that work. So the PM would provide a way and method, then I would solve the problem accordingly." (TMD – I3 – 335-337)*

This knowledge sub-domain is particularly useful in situations where a problem has occurred that the project manager cannot solve by merely using his own knowledge. The project manager can recommend somebody who has the appropriate knowledge regarding the problem. The suggested person can be an employee in one of the organisations where the project is taking place or some experts the project manager has developed relations with through networking. For example, when there are concerns other than merely design issues – such as product costs – the project manager from the design institute would share his suggestion and direct investing project managers to the right contact, such as relevant factories fur further details.

> *"We told him (investor) about the different forms (of installing air circulation and conditioner) in general. Sometimes he might consider the cost; the cost can be high or low. Sometimes we are not very clear with the cost, so we would give the contact details of the factory directly. We would say you can communicate with the factory and let us know the result after deciding." (PMD –I5 – 458-461)*

The knowledge of human resources selection and conflict resolution are focused on members and groups inside the project. The sharing of these assists in creating a

positive environment in which to conduct the project. External knowledge sourcing is the external dimension for the category of knowledge about people, helping to increase the efficiency and usage of knowledge that is required by the project.

4.1.5 Strategic and operational knowledge for project business

Strategic and operational knowledge for project business refers to the project manager's understanding of the business value and objectives and how to achieve them. It can include the project manager's personal strategies and ways to operate and manage the project more effectively, such as how to act in the industrial market and political environment. Compared to other knowledge domains, the domain of strategic and operational knowledge for project business exists at a more strategic level to guide the direction and development of the project, by focusing on its goals and values.

Organisational self-interests

Knowledge of organisational self-interests refers to the awareness and expression about the organisation the project manager is employed by, in terms of its interests, concerns, position within the project and main focuses. The sharing of organisational self-interests knowledge serves the purpose of fulfilling the needs of different participating organisations and maximising investment effectiveness. Knowledge pertaining to this sub-domain is shared throughout three phases of the project with different emphasis and perspectives.

In the first conceptualisation phase of the project, knowledge about organisational self-interests is shared between the investing company and the architectural design institute, with the focus and aim of reaching agreements on the project plan. For example, in order to maximise the usage of available area, project managers need to share their notion and suggestion on how to effectively arrange and design the construction building. This means they need to seek a balance between the investor's requirements and obeying or following relevant design and construction rules and principles. During the sharing process, disagreements and conflicts between the two organisations can occur due to their different interests and positions within the project; the investing company places an emphasis on the appearance and uniqueness of the building, while the design institute is more concerned about safety issues and thus

tends to adopt conventional methods of design in accordance with regulations. The quotations below from interviewing a project manager in the design institute and a project manager in the investing company illustrate these differences.

> *"The main thing is to express our own reasons and try our best to convince the project managers form the investing company. But sometimes the investing project managers would say that they have their reasons too." (CED – I4 – 139-140)*

> *"Usually the design institute always does things according to books or regulations. We may not know much about these books or regulations, and thus we think there shouldn't be any problem to do things this way. But the design institute insists to do things according to the books and regulations. This is the time when conflicts can happen." (PMI – I10 – 132-134)*

Because of the differences, sometimes the requirements proposed by the investing project manager can be declined or rejected by the project manager from the architectural design institute as they are against the architectural principles or regulations. However, the investor insists that from their work experience and views these requirements have been completed in other projects. Confronted with these types of disagreements, project managers from the two organisations need to share their concerns in order to seek a mutual solution; this process is often influenced by their own work experience and practical ways of thinking.

> *"Actually when we communicate with the investor, some of their requirements are problematic. We need to judge and know - for example each room or each floor of the building has its own function - in the condition of fulfilling its function, how to maximize its advantages, meet the regulation standards and fulfil its usage purpose." (PMI – I8 – 87-91)*

The sharing of organisational self-interests is based on the principle that the investing company pays the other participating organisations and therefore their needs and interests need to be guaranteed. As part of this condition, sharing knowledge can help all participating companies in achieving satisfactory outcomes.

> *"This is a very complex process. For example for a small part of the project, how many people are required and how many days does it need to complete; after which construction team does this one need to enter; before which construction work does this one need to be completed - it is a very accurate process. When planning it, for example there might be ten construction tasks need to be undertaken at the same time: these ten works all have their restrictions and limitations such as which one needs to be done ahead of or after which one - these are set knowledge" (PMI – I8 – 129-133)*

As mentioned in Section 4.1.2, knowledge of time frame is related linked to the knowledge of organisational self-interest; negotiating on time frame between different participating organisations can be considered as a dimension of sharing organisational self-interests. From the point-of-view of the investing company, they expect the design institute and construction company to complete their work efficiently within a time limit whilst meeting quality expectations. However, the design institute and the construction company are on the contrary as they prefer longer and more flexible working time. Particularly at the construction stage of the project, the construction work is outsourced to different construction groups, which are under the charge of the construction company. Each construction group has its corresponding task, and their tasks can happen simultaneously, across one another and sequentially. Thus, it is important to share their own interest of the company, and eventually consider these from a comprehensive perspective to allocate the groups in an appropriate way. The main principle is to minimize disruptions and conflicts among different group and guarantee the best working efficiency.

Tacit business rules

Knowledge about tacit business rules pertains to the understanding of hidden rules with regard to both internally operating the project and externally coping with business partners and governmental institutes. In particular, it refers to the business rules that are accumulated from the project manager's experience or commonly accepted by people, but not explicitly written down anywhere. For example, in the bidding and tendering process for construction groups, which takes place at the beginning of the third phase, the decision-making is based on both the project scale and applying the

project manager's reflection of their own experience and management related knowledge to the current project. The process has explicit characteristics as it contains certain procedures and steps that need to be followed such as how many tenders to recruit, what classification-levelled groups to recruit and from what cities or areas to recruit. However, it also involves a strong tacit nature in decision-making; what characteristic, style and previous experience should the outsourced construction groups have, and how to arrange them according to the project needs.

> *"We need to compare prices and call for bids and then do construction. There is a large amount of work before construction. It's not like we just call for bids and then they start working. Some bidding companies might fake their achievements, so we need to undertake lots of work to investigate. We need to know whether they have done some similar projects before. Also, starred hotels have their own standards." (PMI – I11 – 78-81)*

Another important knowledge component in tacit business rules is the understanding of how government institutes work, i.e. how Chinese governmental institutes process applications and approvals. For example, project managers need to share their knowledge about when to submit the design application and how to communicate with the governmental institutes in order to make their work flow faster. Knowledge of governmental-related business rules is most frequently shared at the ending of each phase, as the result of each stage needs to be officially approved by the local government before the sequential phase can be conducted. Specifically, the result of the first phase is the formal project plan and it needs to be approved by the Xingtai Bureau of Construction before starting the architectural design. Similarly, the construction blueprint from the design needs to be officially agreed by the government before the construction work starts. By knowing how to guarantee quick government approval, project efficiency can be increased.

> *"For example communication with different institutes such as design institute and the City Construction Bureau can be better as we will have more information and knowledge, and familiar with the institutes. … One of the most important reasons is that you need to be skilful at the business and the fundamental technical knowledge. This is very important. If you only show your*

tempers and know nothing when team members ask you questions, you cannot solve the issues and thus cannot build personal prestige. If you have solid fundamental knowledge and techniques, and be able to solve the problems they asked about, the personal prestige will be formed." (PMI – I9 – 138-145)

Knowledge of tacit business rules is usually gained through work experience. Sharing relevant knowledge and following these rules can assist in operating the project in a more efficient manner. In particular, it helps to acquire relevant official approval for the project more efficiently, and saves efforts and investments from the companies involved in the project. Besides, as revealed by the quotation above, knowledge of tacit business rules can also help the project manager to build personal authority and reputation among team members. This is related to the skill of building personal authority which will be discussed in Section 4.2.3.3.

Contextual knowledge for the construction industry

Contextual knowledge for the construction industry contains two important dimensions: 1) knowledge of current new issues and hot topics in the construction industry, 2) anticipation of its development trends. The new issues and hot topics relates to current trends in the luxury hotel field and construction industry, including new concepts, design themes and construction materials that receive broad interest and popularity. This also involves the project manager's understanding of how this can potentially affect the implementation of the current project. For example, the opinions on the construction materials, products, types and trends in the market need to be shared before making final decisions.

"For example for my functioning area, investor doesn't know there are different forms or types of air conditioning control. I would introduce these knowledge to them in terms of how each type functions, what are needed, etc. … Like a flow, like what are the different types of models of air conditioning systems. I would share this knowledge with them, then let them chose which one is most suitable for them." (PMD – I6 – 220-224)

The sharing of new issues and hot topics knowledge related to the construction side is usually shared from the construction project manager and the design project manager to the investor, as they are more familiar with the working areas. It is shared

throughout all three phases of the project. This can provide some background knowledge and help the investor to make the most appropriate decision. Thus, this knowledge sub-domain is linked with the knowledge of purchasing suggestion (see Section 4.1.3). Knowledge regarding the hotel field is shared among project managers inside the investing company and from investing project managers to the design participants. It is shared in the first conceptualisation phase with the aim of formulating the most appropriate project plan.

> *"(We need) more new knowledge such as new materials, so that we can apply them in construction more scientifically." (PMI – I10 – 165)*

The other dimension of contextual knowledge is about the project manager's anticipation and sense of how the construction industry and particularly the hotel industry would trend and develop in the near future. For example, understand the design trends within the hospitality industry and how to ensure a design that retains a modern feel into the future. This sub-domain of knowledge is very critical from the business management and operation perspective, as it can influence whether the project meets customer expectation and requirements, both at present and in the future.

> *"For example the arrangement for functions, what are the trends for restaurant /dining development? We need to consider those." (SMI – I13 – 180-181)*

The anticipation within the industrial context also includes an aspect dimension of anticipating the influence of political policies on industrial trends and development. Project managers need to be aware of the current political environment and anticipate its future direction. In China, Communist Party has a significant influence on the country, and their policies can large affect the development and trends within the hospitality industry. It is vital that awareness of this situation is shared, as it can assist in anticipating the direction of development for the industry – in this case the hospitality and construction industries – and assist in the smooth running of the project.

> *"As the PM, first for political aspect, we are now under the lead of Communist Party, so we need to be politically approved. … For example at the beginning of*

planning the hotel, we sensed that the leading of new President Xi will focus a lot on anti-corruption, so we may not have many luxury rooms booked by or for the government. We put a lot of emphasis on planning and designing the halls which can be used by citizens such as marriage hall, and we didn't build many luxury rooms as usual." (SMI – I13 – 182-186)

Sharing contextual knowledge for the construction industry contributes to link the current project to the nature of the hotel industry and to the specific context of Xingtai City. The two dimensions of new issues and hot topics, and the anticipation of the hospitality industry compensate each other in the way that knowing and sharing of new issues and hot topics helps the project manager to anticipate the trends within the industry.

Hotel operational knowledge

Hotel operational knowledge refers to the suggestions of the project manager – usually from the investing company – about how to design and construct the project in order to facilitate better hotel operations in future. Throughout the design and construction phases, the project manager needs to have multi-faceted knowledge of the different operations that will be part of the future hotel operation, such as how the dining room should be designed and how to arrange the space of the hotel.

"Another thing is you need to understand hotel operation. For example for interior and exterior fixture, PM needs to consider space arrangement when communicating with designer. If the PM is expertise in this area, he would understand immediately when the designer shares knowledge with him, and it is easier to reach agreement. If he's not expert, it would be more difficult." (SMI – I13 – 248-251)

As this research is focused on the first three stages of the construction project – conceptualisation, design and construction – the usage and operation of the hotel is not within the discussion scope of the researcher. The hotel operational knowledge here is focused on applying the vision and experience of operation into the design and construction stages. Throughout the project, the project manager from the investing company should always be aware of the hotel operations that need to take place after the construction is completed. They need to share their operational concerns with the

other two participating companies as this can assist in better planning and implementing the project.

4.1.6 Summary and theoretical implications

This section addressed the first research objective of identifying and exploring different domains of knowledge that project managers need to share in their practice in the construction industry. Five knowledge domains were discussed within the section, namely, knowledge of risk, planning, implementation, people, and strategic and operational knowledge for project business, together with their corresponding sub-domains of knowledge.

As presented in this section, the sharing of a particular domain of knowledge takes place at certain phases of a project, revealing both the sequential and dynamic nature of knowledge sharing within a construction project. Through analysing the collected data in this study, the knowledge that needs to be shared by project managers is largely aligned with the sequence of a project lifecycle. From the broad perspective on knowledge domains, knowledge of planning tends to focus on the first phase of the project (despite that some of the knowledge can also be used for the second and third phases when timely or an urgent plan is needed due to unexpected changes), because this domain is concerned with conceptualising and planning issues before the actual design and construction work begin. The category of knowledge about implementation tends to be shared during the second and third phases as this knowledge domain accentuates the issues that need to be considered and the problems that can occur during the design and construction stages. Knowledge of risk, people, and strategic and operational knowledge for project business are the domains without significant emphasis on one particular phase and need to be shared throughout the project. In terms of knowledge sub-domains, some that fall under a knowledge category also follow a sequential order in terms of being shared. For example, under the knowledge domain of planning, the discussion of balancing between appearance and utilisation happened after sharing the ideas about hotel style and early concept and requirement of investing. Also, under the knowledge domain of implementation, sharing knowledge pertaining to the sub-domains of emergent investing requirement, unplanned design

changes, and requirement and regulation solutions sometimes can happen sequentially.

More importantly, the knowledge pertaining to different domains are of dynamic nature. Firstly, the knowledge is not merely static or exclusive embedded in the project managers' mind, but rather an ongoing accomplishment that constitute and accumulate as project managers engage in project work and sharing knowledge with others. For example, when one project manager shares knowledge about planning and reflects on previous experience with other project managers, the project manager is also receiving feedbacks and others' knowledge in the communication process. Secondly, the variety of knowledge domains also reveals the dynamic nature and the demand for dynamic knowledge management and knowledge sharing. Many unplanned situations can happen within the construction project and timely sharing of adequate knowledge is important in terms of problem solving and improving work efficiency.

The five knowledge domains are also interconnected and interact with each other. Each domain is focused on one type of knowledge, but there are overlaps between and among knowledge sub-domains under different domains. The sub-domain of blueprint fieldwork application (under the domain of knowledge of implementation) and the sub-domain of potential risk in design (under the domain of knowledge of risk) overlap in that they are both concerned with the architectural design work. Sharing knowledge pertaining to these two sub-domains can cause some changes in the design work. However, they differ in terms of their focuses and sharing phases. Knowledge of risk in design is mainly shared in the second phase of the project; it overlooks the design from a generic perspective and addresses the issue of what potential problems the design can cause via practical orientation and assumptions. The blueprint fieldwork application knowledge is mostly shared during the construction phase after the blueprint is officially approved, and focuses on very detailed issues identified during the construction work. Similarly, the sub-domains of organisational self-interests (under category of strategic and operational knowledge for project business) and time frame (under the knowledge domain of planning) are interconnected because from a broad perspective, they both serve the purpose of planning the project on the basis of

fulfilling the interests of all participating companies, and are both shared throughout the three phases of the project. However, they are different in in terms of the former one is focused on the organisational self-interests such as what is the standing of the organisation, and the latter sub-domain is concerned with time frame negotiation such as how long the organisation needs to complete a particular task. Additionally, knowledge of market segmentation (under category of planning) involves understandings of the practical usage of a hotel in terms of 'comfort' and 'luxury'. This is in accordance with the sub-domain, knowledge of balance between appearance and utilisation, under the domain of planning. Nevertheless, they have varied content for sharing: knowledge of market segmentation deals with fitting the hotel project into an appropriate market sector and class of consumers, while knowledge of appearance and utilisation balancing is focused on reaching an agreement between a luxurious look and efficient utilisation of the hotel.

There are some certain knowledge domains that the participating organisations have diverse perspectives on and attach different levels of importance to. This can lead to their own priorities in conducting the work, and cause potential conflicts. The tensions and potential conflicts are reflected in different knowledge sub-domains as summarised in Table 4.2. These include hidden threats to the long-term sustainability of the building (between the investing company and the construction company), balance between appearance and utilisation (between the investing company and the design institute), blueprint fieldwork application (between the design institute and the construction company), emergent investing requirements (between the investing company and the design institute) and purchasing suggestion (between the investing company and the construction company). The substantial reasons behind this are the different perspectives and positions within the project of the participating companies towards some certain situations or issues. The sharing and communication of these domains assist them in understanding each other and thus reduces the tensions within the project. For example, for the hidden threads to the long-term sustainability of the building, the investing company has more concerns and interests compared to the construction organisation, as the former is more concerned with long-term usage and the latter more with the completion of current work. The sharing of this knowledge can

help reduce potential conflicts. In this sense, it reveals different institutional logics that knowledge sharing can potentially harmonise.

Knowledge sub-domain	Relevant domain	Organisations involved	Examples of Different perspectives
Hidden threats to the long-term sustainability of the building	Knowledge of risk	Investing company and Construction company	The investing company carries out the role of conceptualising the project and operating the project after completion; they are more concerned with long-term usage and sustainability. Whereas for the construction company, their goal focuses on merely completing the current work and thus it pays less attention to the long-term sustainability.
Balance between appearance and utilisation	Knowledge of planning	Investing company and Architectural design institute	Both the investing company and the design institute consider utilisation to be very important. However, the appearance of the building is also considered to be important by the investing company. Sometimes compared to the design institute, the investing company places considerably greater importance on appearance than utilisation.
Blueprint fieldwork application	Knowledge of implement ation	Architectural design institute and Construction company	There are differences in expertise leading to divergent perspectives between the design institute and the construction company. The design institute is focused on the principles

			and complying to standards whilst the construction company is very practical oriented. For example, project managers from the design institute sometimes create complex blueprint, as long as the design follows designing principles and standards. However, project managers in the construction company suggest that sometimes the blueprint is too difficult to be applied to the construction due to its complexity. As a result, some design work cannot be practically applied in the construction.
Emergent investing requirements	Knowledge of implement ation	Investing company and Architectural design institute	Project managers from the investing company pursue more the sense of luxury and a polished design, and blame the design institute for being too conservative rather than innovative in terms of the architectural design. Project managers from the design institute however, are more concerned about practical and safety issues.
Purchasing suggestion	Knowledge of implement ation	Investing company and Construction company	The construction company seeks to make savings on materials, while the investing company attaches more importance on product quality as this can affect the operation afterwards. When there are different preferences

			in purchasing, project managers need to explain their reasons and the position of their organisations.

Table 4.2, Summary of different organisational perspectives towards certain knowledge domains and sub-domains

Finally, the five knowledge domains transcend the scope of technical or engineering knowledge. This reveals the fact that tacit knowledge about the project (including risk, planning, implementation, people, and strategic and operational knowledge) is of significant importance in conducting construction projects. To achieve project success, it is important for project managers to acquire proper skills to share the knowledge pertaining to these five domains.

4.2 Skills facilitating knowledge sharing

This section responds to the second research objective, which is also directly related to the research question, of identifying and exploring different skills that support project managers to share the required knowledge. This part of the findings is summarised through the concept map as shown in Figure 4.3. The core skills facilitating knowledge sharing practice are composed of three categories, including social cognitive skills, interpersonal skills and strategic orientation skills. These three categories are different in nature, while they are also inter-connected and need to be combined in application during project manager's knowledge sharing practices.

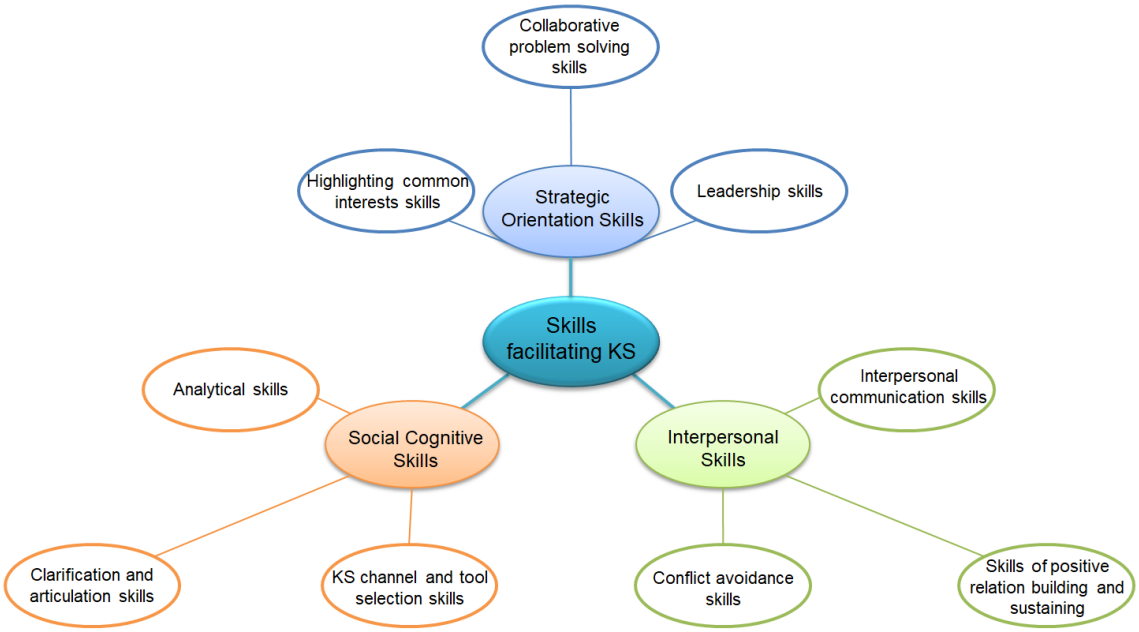


Figure 4.3: Concept map of skills contributing to knowledge sharing

Social cognitive skills refer to the capabilities of project managers to perceive knowledge differences between themselves and others, analyse different situations, and generate means to balance the differences and to reach mutual understandings via sharing. As the construction project is composed of different organisations, and even inside one organisation project members are responsible for different duties, it is common for interpretative differences and unclear meanings to occur among participants. Social cognitive skills are focused on the project manager as the person to perceive opinions from others and realise the knowledge differences during interactions, in order to deliver adequate knowledge. This set of skills also enables project managers to identify appropriate approaches to share. Therefore, social cognitive skills involve a lot of thinking, processing, analysing and reasoning. For many occasions during knowledge sharing, the application of social cognitive skills usually takes place before the actual sharing with the knowledge receiver begins. For the project phases discussed in the introduction of this chapter, this set of skills can be applied throughout the three phases of project work. It is particularly useful for the design and construction phases as there are more tasks and participants involved, which makes it more challenging in generating and reaching shared meanings.

Interpersonal skills are used by project managers to establish and build positive relations with project participants while working on the project. The skills set enables the project manager to socially interact, understand and communicate with the knowledge receiver with the aim of sharing knowledge, resolving conflicts and finally achieving the knowledge sharing goals. Compared to the social-cognitive skills which enable one-way sharing from the project manager to the receiver, interpersonal skills are focused on two-way interactions between the project manager and the knowledge receiver. One of the basic aims of knowledge sharing practices is that the knowledge receiver successfully receives, understands and applies the shared knowledge. Interpersonal skills equip project managers with capabilities of interacting with knowledge receivers and thus are vital to be obtained and applied. Moreover, interpersonal skills enable project managers to effectively communicate, build positive relations and manage conflicts, which can generate a positive project environment for sharing knowledge. This can also positively influence the application of social cognitive skills and strategic and business skills.

Strategic orientation skills, placed at the top of the triangle on the concept map, are goal-oriented in the sense that they support the achievement of business objectives. They pertain to the skills of visioning the project for its long-term success, leading the project team and sharing relevant knowledge to project members accordingly. They assist in generating and sharing common interests and values, especially when different interests and disagreements occur among project participants. This skills set can be particularly useful in addressing problems and conflicts in interests, i.e. when conflicts in interests occur among different participating organisations and stakeholders in the project. Each construction project is generated by the need of the investor and thus the goals and demands from the investor can be viewed as the guidance for project development. The role of the project manager is primarily one of monitoring, guiding and directing work rather than actively engaging in the specific design or construction details itself. This set of skills assist the project manager in coordinating and directing the sharing of knowledge, especially in positioning and ensuring that the sharing of knowledge serves the needs of the business.

The application of social cognitive skills can help to improve the effect of interpersonal skills, especially the interpersonal communication skills, as they are utilised to generate ways of providing and sharing common meanings and mutual understandings when different interpretations exist. Social cognitive skills are also the base and foundation for being able to develop and apply strategic orientation skills, such as being able to analyse, clarify and select appropriate methods to share; these are fundamentally important and basic skills when addressing higher-level strategic issues. Strategic orientation skills, in return, make it easier to apply social cognitive skills in sharing knowledge when the conflicts are addressed and common goals are agreed. Interpersonal skills function as an extra layer in improving the effectiveness of applications of social cognitive skills and strategic orientation skills, because a positive project environment and relations make members and participants more willing to listen and understand the knowledge being shared. Meanwhile, the applications of social cognitive skills and strategic orientation skills help to improve the application efficiency of interpersonal skills by addressing differences in understandings and interests. The three categories of skills together with their sub-categories and codes are presented and discussed sequentially in the following subsections.

4.2.1 Social cognitive skills

Social cognitive skills are concerned with how the project manager perceives and analyses other people and situations, especially the involved differences in knowledge, as well as how they process and apply individual knowledge accordingly. The overall aim of social cognitive skills is to reach mutual understandings of the shared meanings. Therefore, the development and application of social-cognitive skills assist the project manager in balancing differences in understanding and enhancing working ties within the project.

Social cognitive skills are composed of three dimensions as presented in the concept map in Figure 4.4. Firstly, the project manager needs to be analytical with regard to different situations, other project participants and the knowledge that he or she wants to share. Analytical skills assist the project manager in achieving this, as this set of skills are focused on processing and relating the project manager's individual knowledge to situations where communications are needed and help to guarantee the knowledge

being shared is the most productive. In the sharing of these analytical thinking and considerations, especially when confronted with interpretative differences and confusions of other project participants, clarification and articulation skills enable the project manager to share knowledge more effectively in terms of being understood and reaching shared meanings with the receiver. The third component of social cognitive skills, knowledge sharing channel and tools selection skills, are focused on selecting the appropriate sharing method and assistant tools, in order to share the knowledge efficiently. From a generic perspective, the analytical skills, clarification and articulation skills and knowledge sharing channel and tool selection skills can be developed and applied following a sequential and logical order. The remainder of this section presents a discussion on these skills and the associated lower-level skills in detail.

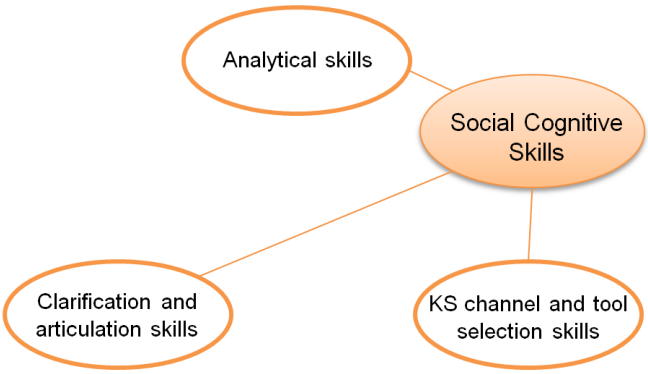


Figure 4.4: Concept map of social cognitive skills

4.2.1.1 Analytical skills

Analytical skills refer to the capability of analysing both different factors and aspects that affect the current situation, and various resources such as similar projects and previous experience, in order to formulate appropriate knowledge and manner to share. With the purpose of analysing the situation and knowledge being shared, their application involves two sequential actions of thinking and determining, i.e. to think about what can be extracted from work experience, other similar projects, construction standards and regulations, various factors of the current situation, and to

determine what knowledge needs to be shared. In some situations, experienced project managers can apply these two actions spontaneously or without preparation.

Analytical skills are composed of five dimensions as shown in the concept map in Figure 4.5. The development of cross-functional and integrational thinking skill assists project managers in analysing and formulating comprehensive solutions in situations where different functional areas are involved. Pro-active thinking skill helps project managers to think ahead and anticipate the potential consequences of an action and thus supports project managers in sharing knowledge that avoids risks and potential threats. Complementing the pro-active thinking, skill of logical thinking improves the thinking process by putting the knowledge in logical orders for the project manager before sharing the knowledge with others. These three skills are concerned with analysing the situation and scenario from a multi-angle perspective.

The other two components of this sub-category, skill of learning from written materials and similar projects and skill of experience reflection and combination, are focused on the project manager's capability in reflection and reflectivity. Learning from written materials and similar projects contributes to the analysis through identifying useful knowledge sources and equipping the project manager with appropriate materials to analyse different situations and formulate knowledge to share. Skill of experience reflection and combination enables the project manager to review previous experience and apply the knowledge into the current knowledge sharing process. Instead of analysing the current features and factors, these two skills focus on analysing, reflecting and applying knowledge obtained from project manager's learning and professional experience. The analytical skills assist the project manager in sharing knowledge through a combination of such multi-angle thinking and reflection and reflectivity skills.

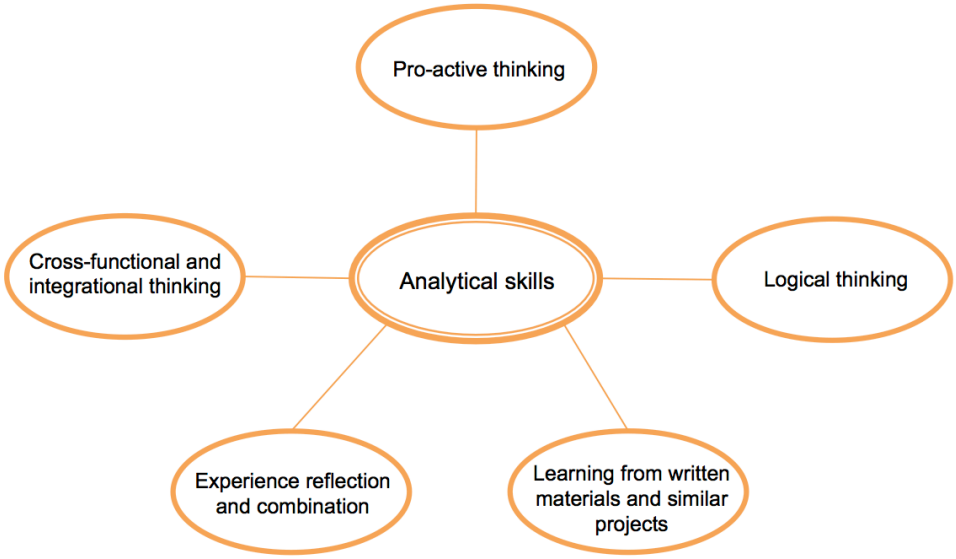


Figure 4.5: Concept map of social cognitive skills – analytical skills

The skill of cross-functional and integrational thinking is defined as the ability to analyse and integrate all functional areas of the construction (i.e. structure, architecture, water circulation, electricity and heating control) without any conflict between them occurring and of informing relevant people of the cross-functional integration. This skill highlights the necessity of having general and overall knowledge of the five functional areas. In a construction project, it is common and typical to consider the connection and integration of the five functional areas especially during the design and construction phases. As the depth of knowledge increases, the project manager can analyse the situations where different functional areas overlap and share adequate knowledge more effectively.

> *"One of the main communications is that when the structure part is under construction, he (the structure PM from investor) needs to consider other functioning areas. Because structure is the first part to be constructed, the PM needs to concern about other details, watering circulations, heating, electricity and extinguishing protections. (PMI – I8 – 9-11)"*

Cross-functional and integrational skill is important for project managers from all three participating companies. When conducting work for the project manager's own functional area, they need to focus not only on their own functional area but also on relevant influences on and from other areas. For example, when the electricity function

needs to make some changes, the project manager needs to check and discuss this with all the other functional areas – architectural, structural, water circulation and heating. This ensures that the change is considered by the other functional areas and that the final design is a good integration without any conflict between the different functional areas. It is easy for this skill to be neglected by project managers from the investing company, as they are usually each in charge of one main functional area, whereas the design and construction project manager needs to oversee the different functional areas as a whole. The development of this skill is often associated with the project manager's work experience as well, exemplified by an interviewee as quoted below:

> *"Sometimes the things are not only in my functioning area, so that I need to know about other areas in general. Knowing other areas is more related to work experience. (PMD –I2 – 103-104)"*

On the basis of the cross-functional and integrational thinking skill which focuses on analysing the current situation, the skill of pro-active thinking is concerned with potential consequences for different resolutions before answering questions or sharing solutions with others. One typical example of applying the pro-active thinking skill in knowledge sharing is that during the first phase of conceptualisation, in order to complete the architectural plan, project managers from the investing company and the design institute need to pro-actively consider how the second phase of the construction blueprint design can be affected and then share their thinking and considerations with team members.

> *"When construction teams come up with questions or doubts, we (investor) need to consider proactively, such as what are the influences for adopting this solution or that solution. Then we (investor PM) need to share with our senior manager and receive his agreement, and then share with the design institute. (PMI – I8 – 59-62)"*

To complement the application of pro-active thinking skill, logical thinking refers to analysing and considering a situation rationally before knowledge sharing needs to be adopted by project managers. For example, when deciding upon time lengths for

different parts of the construction work, project managers from the investing company need to analyse it from the perspective of architectural functional area, and decide to what extent the construction work needs to be completed before the next stage (i.e. interior fixture) can start. The project manager then shares the time lengths, as well as the reasons for them, with the construction groups.

For the reflection and reflectivity dimension of analytical skills, the skill of learning from written materials and similar projects highlights the importance of analysing through knowledge acquisition and internalisation. The written materials include relevant books, standards, laws and regulation items in the construction industry. As discussed in the implementation knowledge domain in Section 4.1, these standards and regulations are written information but can be interpreted and implemented in different ways. Learning from regulation is about the project manager's learning capability in terms of knowledge seeking, able to understand and internalise standards and regulations. It helps to enrich their knowledge, as well as to better explain themselves when sharing their knowledge with others.

> *"I didn't know what to do either. It was also my first time to conduct a five star hotel, so I've been always studying. I always read books and national standards, and conduct my work according to the standards. Internationally, there are international standards as well including what height and size the places need to meet. (PMI – I11 - 276-278)"*

The learning from similar projects part of this skill refers to identifying construction cases that are similar to the one the project manager is working on, especially similar projects in the same city, and more importantly to absorb relevant experience and lessons from these cases. The focus is in terms of their successes, failures and associated factors. For example, when some problems or innovation issues occur in the current work, the project manager can refer to similar projects in terms of how they dealt with relevant situations. This assists the project manager in enhancing individual knowledge, avoiding failures that occurred in other projects and using these cases as vivid examples when sharing knowledge with others. With this richness of knowledge, it is also easier for the project manager to develop his multi-angle perspective related skills and to share knowledge more efficiently with team members.

"For example at the beginning, we went to other cities to study in terms of fixture styles. After that I shared my knowledge and experience with other PMs in charge of structure, facilities, interior and exterior fixture... For the hotel especially during preparation, many people go through wrong or difficult ways. For example, Wanfeng (another five-star hotel in Xingtai City) went through many difficult paths due to lack of work experience... It is like we learn many things from their cases... It can be counted as work experience, or failure lessons. (SMI – I13 – 172-178)"

Compared to learning, the skill of experience reflection and combination is more focused on reflecting on previous experience and applying this to the current project. The two elements involved are experience reflection and experience combination. Reflecting on previous experience and applying it to the current project refers to the skill of analysing previous work experience and critically applying it to the current situation during the sharing of knowledge. Through referring to previous work experience, the project manager can analyse situations more critically and share his understanding in a more comprehensive and detailed manner.

"For example the extractor fan should be with no noise at all, which we cannot find the style in Xingtai City. We didn't know how to construct that either. So we went to big hotels in Beijing to visit and learn... We always learn and practice, accumulating experiences." (PMI – I11 – 306-308)

The reflection is particularly useful when there is a disagreement in the project work. Previous work experience is a type of knowledge source for the project manager to consider the current situation and can also be used as vivid examples during the process of sharing knowledge with others. One example given by the interviewees is that there are differences in the climate between the south and north of China. When the construction group form the south argues their way of construction, the project manager needs to reflect on his work experience, consider the differences between the south and the north, and then explain why that way of construction does not work in the north. The relevant quotation is listed below:

"For example mopping, in the south they… But according to my previous work experience there can be black spots on the ceiling. But the construction teams argue that they did it before and nothing happened. I analysed that due to the

differences in weather and climate, such as summer is wet in our area while dry in the northwest. If it's dry, the black spots won't show. (PMI – I15 – 83-95)"

The other component of experience combination skill is concerned with combining the project manager's own work experience with the experience from other people during the process of knowledge sharing, with the aim of seeking a mutual or better solution. It is particularly useful in the situation of sharing knowledge between different project managers. For example, when a project manager in charge of interior and exterior fixtures from the investing company communicates about design effect with the designer, they should have the skill of combining the knowledge of theoretical design and practical requirements, in order to better share the knowledge from each perspective and to find a solution for the situation.

"Also they need to accord to personal experience. The designer has its design experience, while the investor needs to refer to actual situations. (PMI – I15 – 218-219)"

A typical situation that requires applying the skill of experience reflection and combination is the discussion about work time length. The whole project is composed of many sequential deadlines. When estimating and deciding on the time length of each stage, project managers from different companies need to reflect on their previous work experience, combine their knowledge and seek an agreement. These discussion processes are often more associated with work experience rather than merely engineering knowledge. The discussion can take place between the investor and the designer, and between the investor and construction groups. For example, the project manager from the investing company needs to analyse architectural functional areas and investment in time and budget, and then decide to what extent the construction work needs to be completed before the next stage starts. Meanwhile, the construction project manager considers the practical construction site-work based on the amount of workload. Reflection on and combining experience needs to be applied in such situations in order to reach a mutual agreement and a better decision.

"As I mentioned, how many working loads would it generate by changing form one floor to three floors and how long would it take. These are estimated according to

work experience. For example when investor asks you about how long we need to finish, we need to give them a quick answer. The time is estimated according to work experience, not from books. From the projects that I've done or seen previously, I make a comparison: how many working loads does the change generate; how many percentage does it count in all the project working loads. (PMD – I1 – 84-90)"

To briefly conclude, the development of analytical skills contributes to the improvement in social-cognitive skills from the perspective of critically analysing both the situation and relevant resources, and comprehensively formulating the knowledge to be shared. Differing from some skills, such as those focused on the two-way sharing of the knowledge and encouraging others to share, the analytical skills assist project managers in analysing, reasoning, acquiring and reflecting the knowledge through multi-angle thinking and revisiting professional experience. This sub-set of skills is often not directly applied when the knowledge sharing is happening or being discussed. Instead, it is aimed at assisting project managers in analysing and organising the knowledge, so that during the actual sharing they have more efficient and productive knowledge to share.

4.2.1.2 Clarification and articulation skills

Clarification and articulation skills refer to the clarification of the intended meanings of the project manager in order to generate mutual understandings and shared meanings with the knowledge receiver, and to improve the effectiveness of knowledge sharing. With different organisations and actors conjoint and present at the construction project, it is common for interpretive differences and understandings towards a particular phrase, item, issue or outcome, to appear. Therefore, project managers need to apply clarification and articulation skills during knowledge sharing in order to generate and reach mutual understanding and shared meanings. During these processes, clarification and articulation skills enable the project manager to formulate logical explanation, and to organise and structure clear methods to clarify the knowledge that he or she wants to share. This is particularly useful when the knowledge that needs to be shared is high complex, or when the project manager has many ideas in their mind.

Differing from analytical skills which are engaged in analysing, thinking and reflecting various issues relating to a situation, clarification and articulation skills are focused on the content of the knowledge that needs to be shared. Another difference is that analytical skills are concerned with the thinking process and mostly applied before the actual sharing starts, whereas clarification and articulation skills are more useful during the sharing.

Clarification and articulation skills contain four dimensions as shown in the concept map in Figure 4.6. These four skills intend to make it easier for knowledge receivers to understand complicated and abstract knowledge that is being shared and they each focus on different perspectives in order to achieve this. The seemingly contradictory skills of making abstract knowledge detailed and understandable and of simplifying interpretation of technical knowledge need to be applied according to the specific situation. Demonstration skill is more useful when actual objectives such as space and construction are involved, as in many of these situations describing and demonstrating are more virtual and easier to be understood compared to the verbal manner.

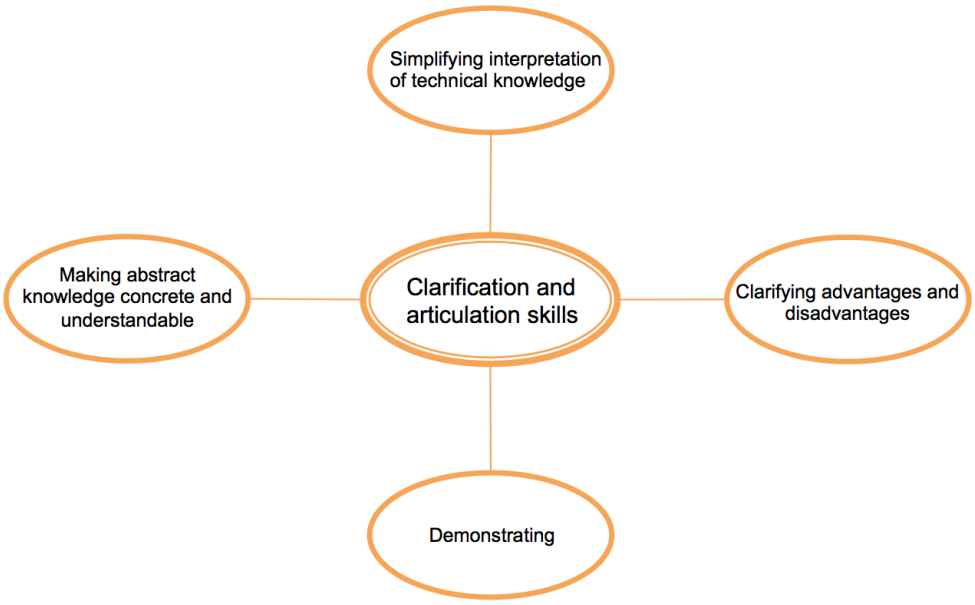


Figure 4.6: Concept map of social cognitive skills – clarification and articulation skills

The skill of making abstract knowledge concrete and understandable is defined as explaining and exemplifying the knowledge that one intends to share with the purpose of making the knowledge detailed enough to be understood. It supports the project

manager when he or she needs to share abstract, complex knowledge or when the argument, statement needs detailed evidence.

> *"For example the time, two weeks are not enough. Then I need to explain to him in details: these are all the work I need to conduct, this part takes X time and that part takes Y time. After adding all the time, even including extra hours after office, I cannot finish it within this amount of time. (PMD –I6 – 94-97)*

As exemplified by the interviewee from the design institute shown below, the project manager in the design institute should be able to explain their working plan and concerns in details when arguing about project time length with the investor. The application of making abstract knowledge concrete and understandable can be with aids of drawing or referring to other construction cases.

> *"If investor doesn't understand, we would draw the regulations and explain the technical knowledge. Make things concrete and detailed. Sometimes through only saying it doesn't work according to regulations, the investor won't understand. So sometimes we draw the regulations and use regulations to explain. (TMD – I2 – 222-227)"*

In relation to other skills in this sub-category, the skills of clarifying advantage and disadvantage, and demonstration, can be adopted as a method to make the abstract knowledge understood by relevant receivers. Additionally, there is also a close relation in application between the skill of experience reflection and combination – discussed in the analytical skills – and the skill of making abstract knowledge concrete and understandable. The reflection can assist the project manager in improving and enhancing the detail and depth of their conversations via referring to their experience as relevant fieldwork examples.

The skill of simplifying interpretation of technical knowledge refers to interpreting the technical knowledge in a direct and non-technical way, so that it can be understood by team members with non-technical backgrounds. In a construction project, team members come from various backgrounds and possess different levels of technical knowledge. For many knowledge sharing occasions, the project manager needs to make others understand his technical or engineering-related knowledge. In the

application of simplifying interpretation skill, a good strategy to adopt is to be able to sharply point to the key issues of a situation or conversation. Usually during a knowledge sharing process, quickly identifying the key issue can draw attentions from the knowledge receivers, and thus guarantees the efficiency of knowledge sharing. Having generic knowledge about different functional areas of the construction project can help project managers to better understand the situation and be able to point to the key issues.

> *"The simpler the better. It can't be too complicated, because the more complicated I explain, the more he doesn't understand. For example the way he constructed in this place, what problems would it lead, what consequences would it be. Then he would understand. (PMI –I15 -199-202)"*

The skill of making abstract knowledge detailed and understandable, and the skill simplifying interpretation of technical knowledge are not opposed to each other because they have different focuses. The former one should be used in the situation when the knowledge needs to be fully and deeply understood by the knowledge receiver, while the latter skill is useful for the occasions that the shared knowledge should be taken as an 'order' and needs to be applied immediately in the project. These two skills act as different roles but complement each other for the clarification and articulation skills sub-category.

The two skills of clarifying advantages and disadvantages, and demonstrating, can assist in the application of making abstract knowledge detailed and understandable and simplifying the interpretation of technical knowledge. The skill of clarifying advantages and disadvantages can assist project managers in analysing a situation via developing a clear mind about the issue being discussed so that the project manager can share relevant knowledge in a clear and comprehensive manner. It is particularly useful when disagreement happens or when there is a decision that needs to be made. For example, when the project manager from the design institute disagrees with the requirement proposed by the investing company, he can use this skill to critically analyse the advantages and disadvantages of the situation in order to comprehensively share his knowledge and to make the knowledge receiver fully understand.

> *"Share the advantages and disadvantages from technical perspective with investor. During communication, I tend to explain to them from technical perspective. I need to let them understand technically why this tube cannot be allocated here, electricity box cannot be fixed this way, regulations etc. I need to let them understand why I am asking them to do this way or why reconstruction is needed. (PMI –I10 – 193-195)"*

As illustrated by the interviewee below, clarifying advantage and disadvantage skill can be applied together with the skill of experience reflection and combination. The reflection on experience can include the advantage and disadvantage in the previous work, which can help to formulate arguments for the current discussion and sharing of knowledge.

> *"For example what system is used; what are the advantages and disadvantages of the system. I think through the real cases to share knowledge can be reflected for the hotel work in future. (PMD –I3 -154-147)"*

Demonstrating skill refers to the project manager sharing the 'how to do' knowledge via practical demonstrations. Actual demonstrations make the knowledge vivid and easier for knowledge receivers to understand. It is often applied during the design process with the aid of drawing, and during the construction stage via on-site visits. It is particularly useful when the knowledge that the project manager intends to share is too abstract.

> *"Some construction team member doesn't know how to conduct some part of the work, and then I would demonstrate to the member. We have seen many of the work anyway. The member may have done two or three, but we know ten. So we have more work experience. (PMI – I15 – 265-266)"*

Clarifying advantages and disadvantages formulates a critical dimension for the clarification and articulation skills. It focuses on analysing a situation scientifically and rationally before sharing and decision making, and thus often involves technical and professional thinking and expression. In comparison, demonstrating skill formulates a practical dimension and angle for the clarification and articulation skills.

4.2.1.3 Knowledge sharing channel and tool selection skills

The skills of knowledge sharing channel and tool selection are focused on the ways and assistances that the project manager can adopt when sharing knowledge with others. Appropriate selection of the channel and tool to use for knowledge sharing is an important factor influencing its effectiveness. The selection skills equip the project manager in deciding the most effective method for sharing.

Skill of knowledge sharing channel selection is defined as identifying and deciding on the most appropriate channel to share knowledge, based on various factors such as the type of knowledge to be shared and the number of people involved. The skill of using appropriate tools to facilitate knowledge sharing refers to selecting and employing useful tools such as visualisation and IT in order to enable and aid the sharing of knowledge. To share knowledge with others, selecting appropriate knowledge sharing channels and tools is one of the most basic and important things that the project manager needs to decide on. The skill of selecting the appropriate channel and assistant tool for knowledge sharing can make it easier for the project manager to share knowledge as well as to improve the effect and result of knowledge sharing.

Figure 4.7 presents three lower-level skills which constitute the selection of the appropriate channel for knowledge sharing and four lower-level skills contributing to the selection of suitable knowledge sharing tools. Two of the most often used channels are to share knowledge through face-to-face communication and by phone conversations. The project manager should have the skill on deciding which channel to use to better share knowledge with others. The location selection skill needs to be applied on the basis of the skill of facilitating face-to-face communication. The four skills focusing on knowledge sharing tools presented in the concept map can act as assistance during the sharing process. Being familiar with and acquiring the tools related skills can enable the project manager to select and apply the most suitable tools in sharing personal knowledge, and thus improving the quality of the knowledge sharing.

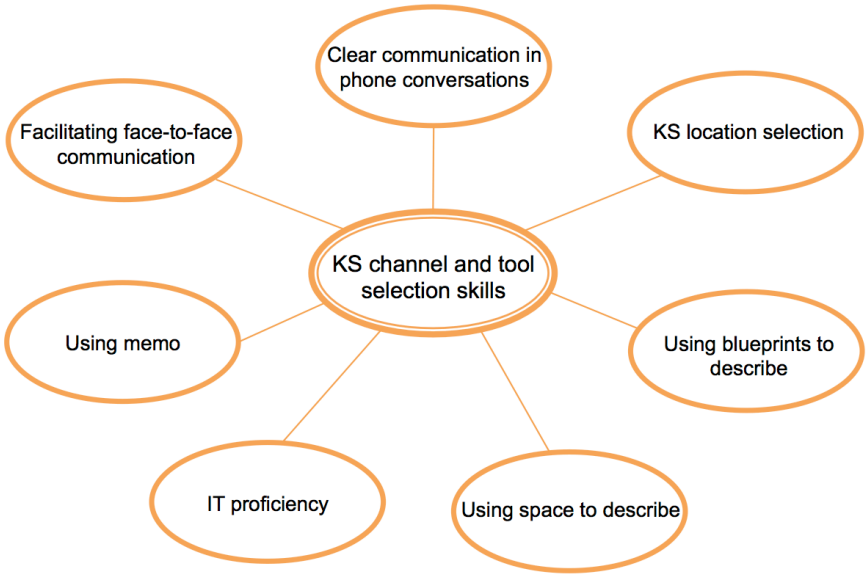


Figure 4.7: Concept map of social cognitive skills – KS channel and tool selection skills

The skills of facilitating face-to-face communication and clear communication in phone conversations can support the project manager in deciding on the most appropriate channel to perform better sharing activities. The project manager should have the skill to set up and facilitate face-to-face knowledge sharing and communication, as this is widely recognised as an efficient way for understanding each other, sharing knowledge and solving problems. This skill needs to be applied especially in situations where some complex knowledge needs to be shared and when more than two people need to be involved in the knowledge sharing process.

> *"If for example we send them a picture, and if they don't understand, we receive some feedbacks and send another picture: I think in this case face-to-face communication is the best. When we need to hand over or check our design pictures, we usually talks to investor and construction teams face-to-face, which is easier to express clearly... People have different levels of knowledge. Some construction workers don't understand when we tried to share knowledge. If he doesn't understand, we have to help him. Face-to-face talk. (PMD – I6 – 294-297)"*

For the face-to-face sharing of knowledge, a strategy adopted by the project managers from the investing company is at the beginning of the project – to sign an agreement with the design institute and construction groups. The agreement is in terms of how

often design and construction people need to visit the investing company, for example three to four times per month. This agreement helps to guarantee that face-to-face knowledge sharing occurs on a regular basis, as quoted below:

> *"We had an agreement with design institute that the designer need to come over to investor site three to four times per month. If there's any problem they need to solve at either investor's place or construction field. In this way most of issues can be shared. For example they come over once a week. (PMI – I15 – 26-27)"*

The skill of clear communication in phone conversations means that the project manager should be able to share knowledge through phone calls in a clear way, so that the knowledge receiver can understand. Compared to face-to-face communication, knowledge sharing through phone calls is easier and saves a lot of time for both the project manager and team members. For some straightforward knowledge, the skill of clear communication in phone conversations assists the project manager in sharing the knowledge efficiently.

> *"For small things if project managers can share clearly through phone, I prefer phone communication. But for some things we have to share face-to-face. It's not about which way I like. If have to say, I prefer phone because it saves times and energy. (TMD – I7 – 10-11)"*

The application of face-to-face communication skill and the skill of communication in phone conversations should be based on the situation and the demand for sharing knowledge, and thus the project manager needs to select the appropriate approach via analysing the real situation.

Knowledge sharing location selection is focused on choosing an appropriate location for sharing knowledge in person, and thus assists the project manager in face-to-face communication facilitation. It is defined as the skill of identifying, selecting and appointing the most appropriate location for face-to-face sharing of knowledge. The selection is based on considerations of various factors such as the type of knowledge, how often it needs to be shared and the number of people involved. For example, when a problem occurs in the construction work and it needs to be addressed

straightaway, the project manager should be able to select the construction site as the location as this is the most efficient solution.

> *"Even during the construction stages, sometimes there are problems occur. Our manager needs to sort out whether the problem is about the blueprint design or something else. Sometimes they need to decide to go to the construction site to share knowledge in order to solve the problem. " (TMD – I5 – 13-15)*

Selecting an appropriate location is crucial because the place where knowledge sharing happens can directly influence the effect of sharing. For a construction project, the most common and typical location where knowledge sharing happens include the construction site, meeting rooms and working office. The application of this skill is particularly useful during the construction stage of the project, as there are more choices of knowledge sharing locations and the sharing of knowledge can involve different organisations.

Selecting appropriate tools relates to the use of blueprints and the use of space can assist project managers in describing ideas and visualising the knowledge that is being shared. The blueprint refers to the design blueprint or the construction blueprint. With the aid of the blueprint, for example pointing to or drawing on a specific area during discussion, the project manager can explain the knowledge in a more virtual and clearer way. This skill is particularly useful when sharing complex knowledge or when there are different companies involved in the knowledge sharing process as the blueprint helps to visualise the knowledge that is being shared, and hence makes it easier to understand for people with different backgrounds.

> *"Sometime we would, for example make a cross section view and see in real construction, can the facilities be arranged or not. Then the manager would draw a draft and arrange it on the draft. Sometimes we different functioning areas are asked to put together our design pictures and analyse together about small issues such as direction of tubes. This is to avoid big potential problems in actual construction. (TMD – I3 – 112-116)"*

Similar to the using blueprint, the skill of using space to describe is also aimed at visualising the knowledge and making it vivid for the knowledge receiver to understand

and accept. This skill refers to using the actual construction space and site to describe and express the project manager's ideas and knowledge.

> *"When we share this knowledge, we ask him to go outside the space to feel, for more than 1000 square meters with that height, he can feel it's safe but there is no extra effect. Then we try to persuade him and he would be more willing to make changes for us. (PMI – I11 – 124-126)"*

The IT proficiency skill can increase the time efficiency of knowledge sharing for the project manager. Besides, project manager's skill of keeping memo when the knowledge occurs to one's mind in daily life and using it during the knowledge sharing process can improve the richness of the knowledge being shared. IT proficiency skill refers to be able to use relevant software such as Computerised 3D model to share the knowledge more efficiently. In the construction project, each company has their intra-net and software which they can use to share information and knowledge. For example, the software package used by the design institute can simultaneous the design drafts and be accessed by team members. In this case, when the project manager needs to share design knowledge with team members, accessing and using the software to look over the design drafts can save time and effort.

> *"We start using a collaborative design software since last year. For example in design process, all other functioning areas are based on architecture design. So when the architecture design changes, the designer needs to let others know and make changes accordingly. If the foundation (architecture design) is not correct, then the design of functioning areas is not correct either. The software enables the changes to be automatically saved that it appears as a new design picture in our intra-net. So other designers can make accordingly changes. In this case, even if the architecture designer forgets to mention about the changes, there shouldn't be problems. (TMD – I2 – 307-312)"*

The skill of using memo is about informally writing down and recording the ideas and thoughts that arise in one's mind, especially while developing solutions and learning new knowledge from people such as consulting experts and visiting other successful construction projects.

"After looking at the design blueprint, as a design person, I think you should write down what you think is the best part of the design and how to show it. I think this can be a way of reflecting the tacit knowledge to explicit. (PMD – I1 – 151-153)"

This skill can help project managers to better internalise the knowledge they learn as well as to remember details when sharing knowledge with others, as quoted from the interview below.

4.2.2 Interpersonal skills

Interpersonal skills are focused on obtaining effective communications, social interactions and building positive personal relations. Effective communication and interaction between the project manager and knowledge receiver is one of the most direct ways in improving the effectiveness of knowledge sharing, as the sender and receiver are directly connected and involved during the sharing. Positive personal relations, especially those built through social interactions between the project manager and others, can assist in generating an environment that encourages sharing of knowledge and ideas. In addition, effective communication and interpersonal relations are conductive to the cooperative characteristic of knowledge sharing. Through generating a friendly atmosphere for the project work, the interpersonal skills also facilitate all project participants to be more willing to communicate. From this perspective, it helps to generate a more collective approach to share knowledge: the knowledge receivers build their thinking and ideas based on the knowledge that was received from the project manager, and thus generate and promote the collective learning and sharing context.

Discovered in this study, interpersonal skills are composed of three sub-sets of skills as shown in Figure 4.8. The interpersonal communication skills are in accordance with the effective communication and interaction part of the interpersonal skills, supporting project managers to effectively interact with knowledge receiver. Interpersonal communication skills are critically important not only in sharing, but also in conveying the sustainable practices expected from project members. The skills of positive relation building and sustaining and conflict avoidance skills are in accordance with the positive relations part of interpersonal skills. These two sub-sets of skills assist the project manager in creating strong ties with other people involved in the project, which helps

to generate a knowledge sharing-friendly environment whilst constraining the occurrence of insufficient sharing due to unfamiliarity with team members.

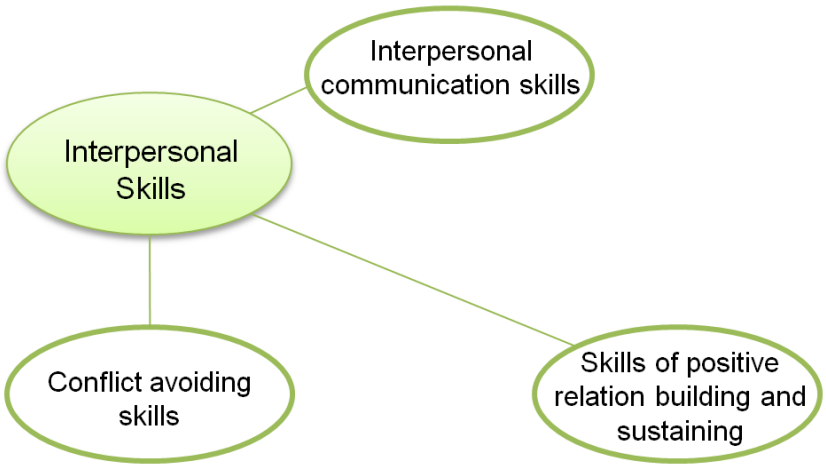


Figure 4.8: Concept map of interpersonal skills

4.2.2.1 Interpersonal communication skills

Inter-personal communication skills refer to the ability to understand knowledge receivers, convey individual ideas and interact with people efficiently. During the sharing process, interpersonal communication skills are very basic and direct in impacting the effectiveness of knowledge sharing. The development and application of interpersonal communication skills can assist the project manager in expressing the knowledge, making receivers more willing to accept and understand the knowledge, and encouraging receivers to interact with him/her. Interpersonal communication skills are composed of and can be developed from five dimensions as shown in Figure 4.9.

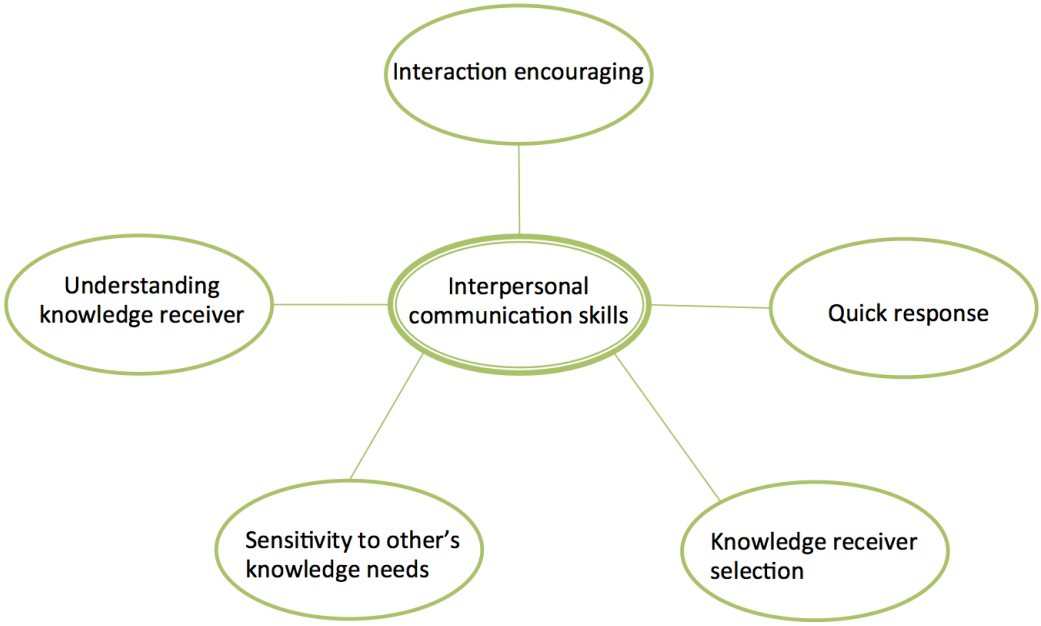


Figure 4.9: Concept map of interpersonal skills – Interpersonal skills

The skill of understanding the knowledge receiver is defined as the skill of reading and understanding knowledge receiver through their reactions when receiving knowledge. This skill helps project manager to recognise whether the shared knowledge is fully understood and accepted. Moreover, it assists in deciding what type of knowledge and to what extent the project manager needs to share and explain. It is therefore important for both before and during knowledge sharing process.

To understand the receiver, firstly, listening is crucial. It not only refers to accurately receiving the messages, but also to interpret and reflect the responses sent from the receiver. Secondly, observation is another important part in understanding the receiver during the sharing. The observation includes body languages such as gestures when receiving knowledge and voice reaction when responding to the knowledge. These body languages and reactions can partially reflect whether the knowledge is understood, and thus help the project manager to read and understand the receiver. For example, when the knowledge is understood, the receiver tends to answer fast and sound but when the receiver does not fully understand he or she may speak slowly and use words with hesitation.

"I think it's easy to figure out whether he undestands or not. If he doesn't understand I can just see through. It can reflect on languages. Sometimes he says he understands it, or doesn't reply anything. Then when reflect on picture what he did wasn't correct. … If he understands, he would reply very fast and straight, yes. If he doesn't understand he tends to reply, 'Ohh okay', with slow speed. Slow speed can reflect that he kind of understand it and kind of doesn't. (CED – I4 – 80-86)"

Understanding knowledge receiver also includes checking the knowledge receiver's understanding, which refers to identify whether the shared knowledge is being understood. Its main aim is to help the project manager decide whether to further explain and to what extent about the knowledge. For example, in terms of the design institute, one way of checking this is to ask the receiver to present the knowledge of the design-drawing sheet. This can assist the project manager in deciding to what extent should the knowledge to be shared and whether more explanation is needed.

"One is through explanation, and the other is after explanation he needs to reflect these on design pictures. Then I can tell whether he understands or not through reading his design picture. (PMD – I1 – 161-168) "

Another important part of understanding knowledge receiver skill is to identify whether the knowledge receiver, usually from another participating company, is bluffing or speaking of his real capability. This requires the combination of observing the receiver's reaction through the knowledge sharing process, as well as reflecting on the person's performance in the project work.

"For example I worked with a person who bluffs a lot about what he did in Shanghai City. But there was water leak in the things he constructed. This proves that he didn't actually do what he was bluffing about, or at least he might have participated but not knowing how to do it. There are other people who don't say much but do actual good work; some people just do the opposite. (PMI – I11 – 272-274)"

The skill of understanding knowledge receiver is crucial for project managers, especially when considering the 'quiet' and 'shy' working culture in the Chinese context. Team members tend to act modestly and quietly in front of managers. The application of this

skill helps the project manager to understand and analyse the response from the knowledge receiver, and thus to communicate with the receiver more effectively.

Interaction encouraging skill focuses on encouraging and persuading others, especially team members from other companies to ask questions and talk about their confusions. It assists the project manager in sharing the needed knowledge more efficiently. For example, the project manager from the design institute should be able to encourage the construction groups to ask questions in terms of the construction blueprint before conducting the actual construction work. This skill is important especially at the beginning of the project, as it helps the project team to better communicate and solve project problems or concerns in the early stages. In application, this skill can also be combined with the skill of understanding knowledge receiver, as the project manager can analyse and understand the knowledge receivers from the questions that they asked.

> *"When delivering construction blueprint, our project manager would remind them to read the blueprint and ask us questions on time. If there is problem we can make changes accordingly, in order to have problems later after construction. It's always oral reminder. Remind them to solve problems in the beginning and not wait to the end. (TMD – I5 – 337-340)"*

In the application of understanding knowledge receiver skill and interaction encouraging skill, the ability to response quickly also needs to be adopted by the project manager. Quick response skill is defined as the skill of fast thinking, understanding and always being ready to answer questions from other people, in order to guarantee the timely and effective sharing of knowledge. It enables the project manager to react to the situation quickly, apply their knowledge and share with others in a timely manner. Throughout the project work, many problematic situations or issues can arise that are beyond the project team's expectation. For a construction project, these issues need to be addressed as a priority in order to save time and make sure the following work can be completed. Therefore, quick response skill is another interpersonal communication skill that a project manager needs to acquire, which adds an extra 'safety-layer' for project managers in communicating with others.

Knowledge receiver selection refers to the skill of identifying an appropriate individual to share relevant knowledge with, and being able to recognise situations when there is a need to change to another knowledge receiver. This skill is useful both inside one company and for other companies within the project. Specifically, the need to change the knowledge receiver usually happens when the current receiver cannot understand something that is outside his/her area of expertise, or is not wanting to communicate. For example, when the construction team worker is not willing to accept, or not able to understand the knowledge shared from the investing project manager, the project manager usually shares the knowledge with the construction project manager instead and asks them to inform the team worker.

> *"Usually I would swap and share knowledge with the construction team leader. Then ask the leader to share with his workers. Sometimes at the construction field when there is conflict between workers, I wouldn't say or share anything (with the worker). (PMI – I15 – 141-142)"*

Being sensitive to others' knowledge needs refers to be considerate of other people in terms of their potential knowledge requirements and initiatively sharing the relevant knowledge with them. The assumption can be based on the project manager's understanding towards his team members via analysing their previous and current work and knowing what their strengths and weaknesses are. Typical examples include, project managers from the investing company sending knowledge to the design institute when they encounter some useful knowledge that the design institute might need; design project managers providing some relevant examples from their previous projects to the investing companies as references; and project managers providing or purchasing books and CDs which are relevant to the knowledge they share with team members so that the receiver can better understand.

> *"The application of some new products or techniques, we would always share with investor. For example the good techniques we used in other case projects that we think they might need in their hotel, we would give investor details and some people to contact. Or sometimes the investor can choose not to use our new techniques, as new technique is not the only approach and there is still traditional way. It depends on investor's willingness. (PMD – I6 – 180-187)"*

This skill should be adopted and applied by project managers from different companies within the project. Being sensitive to others' knowledge needs can help create a positive environment for knowledge sharing where people are considerate of each other. By understanding member's potential knowledge needs, project managers can get to know their team better. This in return makes team members more willing to corporate in the project work.

> *"If the knowledge relevant to some functioning areas, I would gather them and share with them together. For example some common issues that need attentions during design, or some better knowledge we discovered from other institutes, or some innovation or different thinkings compared to our traditional ways etc., I would share with them. It is always timely. (PMD – I6 – 233-236)"*

4.2.2.2 Skills of building and sustaining positive relations

Building and sustaining positive relations is an important component of interpersonal skills. Its aim is to create and maintain constructive interpersonal relations with people, including both those involved in the project – like team members – and those useful for the project such as external consultants and relevant departments. Through forming good relationships with project participants, the project manager can make them more willing to listen and understand the knowledge being shared. Establishing strong personal relationships with external people who can be helpful for the project - for example, experts in the construction field - can assist the project manager in identifying an appropriate consultant when needed and in obtaining more insight knowledge of the construction industry. It can also enrich the project manager's current knowledge about certain specific areas and hence enrich the knowledge that he or she shares.

Therefore, skills of building and sustaining positive relations function as an external support in creating a positive and friendly environment for sharing knowledge. As shown in Figure 4.10, this sub-category of skills is composed of four dimensions.

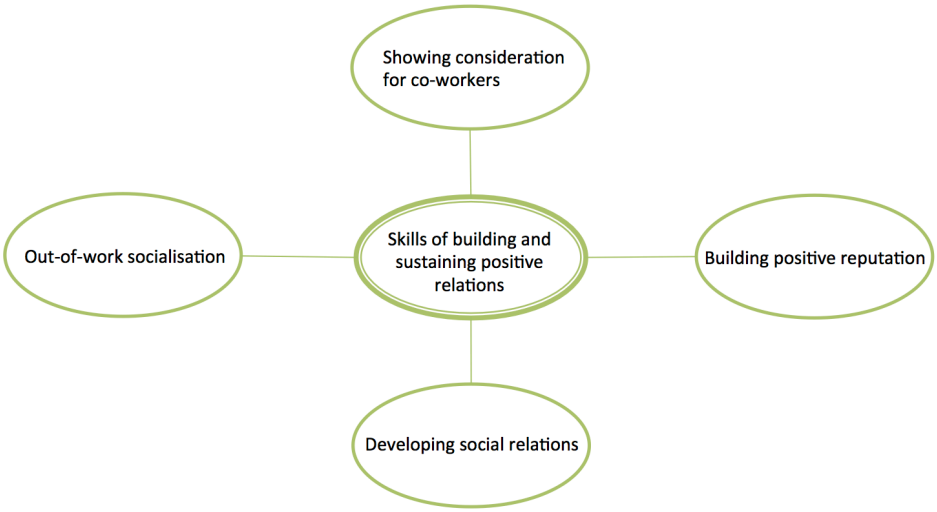


Figure 4.10: Concept map of interpersonal skills –skills of building and sustaining positive relations

The skill of out-of-work socialisation refers to the arrangement of appropriate social activities during out-of-work time, usually with some of the project team members. This is viewed more than merely a social activity in Chinese culture. It can help the project manager to build personal image and leadership via an informal way, which makes the knowledge receivers more willing to listen during the processes of knowledge sharing. During such socialisation activities, the project manager can better explain themselves if any problems or conflicts have happened before.

> *"We need to show care for team members. I tend to show my care. If the work is tiring sometimes, I would treat them dinner using my own money, and we can communicate. If my attitude wasn't good earlier, I would mention it during the dinner and they would understand. (PMI – I10 – 232-236)"*

One typical activity that people usually engage in during socialisation is to have meals together. The common strategy adopted by the project manager from the investing company is that they set the principle of not letting the other two companies treat the investing people to dinner. On the contrary, they treat the construction or design group if the work is completed on time or to a high quality. This helps to increase the harmony and care between the investor and design or construction groups, and hence creates a cooperating environment for knowledge sharing.

"Usually we require our team members not to have dinner with them. But if they complete construction work on time, we would treat them dinners. (SMI – I13 – 139-140)"

The application of out-of-work socialisation skill also requires the project manager to differentiate between a work and out-of-work manner, i.e. differentiating and adjusting personal behaviour and attitude towards knowledge sharing and knowledge receivers – especially with regards to team members who are under their direct guidance. knowledge sharing during work time tends to be more formal and serious, while after work, it can be more relaxed and informal. This skill helps the project manager to adjust his/her manner in sharing knowledge with others accordingly.

"I tend to be serious during work and smile after work. Being serious at can help me to build my authority and saves time. But I need to build good relationships with my team members, so I tend to be smiley to them when we are not at working time. (PMI – I10 – 241-243)"

The out-of-work socialisation skill is a very important part of building and sustaining positive relations, especially in the context of Chinese culture. If this skill is neglected by the project manager, it can be difficult to build a close inter-personal relationship with project members or to generate a knowledge-sharing friendly environment within the project. Also, if this skill is adopted and applied in an incorrect manner, it can cause some tension in the working environment, which can negatively affect the sharing of knowledge from the project manager.

The skill of showing consideration for co-workers is defined as understanding the needs and position of colleagues and showing consideration for them, in order to build and maintain positive and on-going relationships. It is usually applied during out of work time. For example, the project manager can be caring towards employees and support them during times when they are facing difficulties or problems, rather than merely being concerned about the project work. This skill can indirectly make employees more willing to receive and internalise the knowledge received from the project manager.

"We need to have management strategies, encourage them more, understand them and show our care. In this way they can conduct their work properly. (SMI – I13 – 101-102)"

Project managers should, according to the particular situations, show considerations when they interact with project participants from other companies. For instance, when employees from the construction group travel a long way to work on the project, the project manager from the investing company should be able to offer help and guide to the group in terms of their daily life such as suggestions on places to eat and where to purchase necessities. Most workers in the Chinese construction industry are not from and are not familiar with the local city where the project is being conducted. Showing consideration and care can indirectly help improve the communication and knowledge sharing between companies. Thus, the skill of maintaining social bonds with co-workers is vital in this setting.

"One thing is when construction teams come here from another city. Sometimes it's not easy to coordinate their water usage and dining issues. So we need to show our care and bring convenience to them. In this way the construction teams can feel the investor is treating then well, which makes it a lot easier to discuss and communicate. There are many specific examples, but through this strategy, many things are easier to solve. This is a method. (SMI – I13 – 137-138 and 153-154)"

Showing consideration for co-workers often involves project managers 'putting' themselves in the position of the knowledge receiver by considering all potential factors that can affect the receiver's situation; thinking about other's situation and reasoning when the person is not willing to cooperate, and considering different factors when others cannot complete their work on time. By doing this, the project manager can express the knowledge in a way that makes the receiver feel that his position and interests are being considered by the project manager and therefore more willing to corporate and accept the knowledge being shared by the manager.

"But sharing also requires skills. Because our team members work hard and they don't have the role of professional manager. The salary is relatively low and they don't have weekend, and sometimes they work longer than official working hours. So humanized management skills are indeed required. I need to let them know

that their hard working is recognised, and often encourage them and discuss with them. Strict requirements need to be combined with humanized management strategy. (SMI – I13 – 94-98)"

The skill of building positive reputation refers to be able to convince others that the person is sincere, honest and reliable, rather than somebody who mis-leads people about his/her capabilities. The aim of this skill is to build trust in the working environment and therefore increase the effectiveness of knowledge sharing.

With a positive reputation, especially in terms of an honest and reliable reputation, the project manager can make knowledge receivers more 'at ease' and willing to listen to the knowledge being shared. The development of this skill therefore, can help to build trust between the project manager and others in terms of the project manager's professionalism, competency and benevolence from team members inside the working company (intra-organisational trust), team members from other companies (inter-organisational trust) and other people (such as government and external experts).

"You should be sincere to other people and make others feel you are reliable and honest... For many outside customers, it is our first time to meet and work with them. The reason they choose us is that we are reliable in technical qualities and have reasonable prices. This responsibility attitude of being sincere can move people in the beginning. (PMD – I6 – 492-494 … 501-506)"

The skill of developing social relations pertains to accumulate different types of resources including knowledge resources and people's contact details. It enables the project manager to become resourceful in both having rich knowledge to share and identifying and guiding the knowledge receiver to suitable contacts for further consultancy.

"I (investor) need to treat them (supplier) as friends. It must be like this. Otherwise it can be troublesome that he doesn't tell details. For example every time when the supplying person comes, I would have dinner with him as I can sign the dinner on behalf of the company. But I need to treat him dinner as friends, and in that way he can have conversations with me and help me with many ideas and suggestions. For example even for wearing green colour clothes, there are eight types of green, which green colour exactly it should be, he would not tell. But if you are friends

with him, he would provide you colour samples with explanations. Interior fixture is quite soft, including wallpapers and curtains, he can provide you samples with appropriate recommendations. If you don't make friends with him, he won't provide very insight information, and can receive commission or kickbacks from suppliers for the materials. ... So this is good for our construction and our investment."(PMI – I11 – 236-244)

For example, project managers should be able to gather and store in their mind some typical design and construction cases, which enable them to express themselves better and refer to detailed examples when sharing knowledge. The skill of developing social relations enriches the project manager's knowledge accumulation in terms of both construction knowledge resources and contacts.

"One is that you must have enough storage of knowledge, so that you can acquire enough cases and materials and then be able to share. For example for some real case projects, you need to know about it and have it in mind, so that you can better share. (PMD – I6 – 347-349)"

The skill of developing social relations is relevant to the problem-solving orientation, which will be discussed in Section 4.2.3.2. Accumulating and obtaining both knowledge resources and contacts can help project managers to formulate solutions for problematic situations.

"During the interior fixture work, the tube was affected. Actually the tubes are not in our area, but since the construction people asked me and I'm a member of investor group, I organised PMs of water circulation, electricity and heating, PMs of interior fixture and we structure people to discuss together and decide a solution. (PMI – I8 – 173-177)"

The development of social relations also assists the project manager in developing knowledge receiver selection skill (as discussed in Section 4.2.2.1). Specifically, by developing better social relations, the project manager can quickly identify appropriate internal and external experts; in situations where the problems need to be solved by consulting with other people, the needed knowledge can be obtained and shared in a timely manner. It is very useful when the required or requested knowledge is beyond

that of the project manager's personal knowledge scope, as it helps to identify the right person to share with and guarantees the timely sharing of knowledge.

> *"We looked for experts from outside and communicate with them. After communication and learning, we shared our knowledge to team members and guide them. We try to be good and make the project with little regrets. (PMI – I11 – 309-311)"*

The skill of developing social relations can also help to identify experts that can provide useful knowledge to the project at a generic level. For example, the project manager can invite people from the Tourist Institute who have an insight into tourism and hotels, to give lectures within the project. Also, the project manager from the design institute can consult with experts in charge of different functional areas about any difficult questions: this helps them to gain new knowledge, as well as enhance their own knowledge, before sharing.

4.2.2.3 Conflict avoidance skills

Conflict avoidance skills are defined as averting negative emotions or arguments among the project team and building a harmonious working environment both inside the organisation and across organisational boundaries within the project. Conflict or contradiction is inevitable in the complex social setting of a project. It is difficult to identify methods or ways that can satisfy the various interests of all the participants. Minimising and avoiding such unnecessary conflict can assist the project manager in avoiding knowledge sharing bias and help to create a positive setting for the sharing and accepting of knowledge. Conflict avoiding skills are another important component of the interpersonal skills. The maintenance of a harmonious working environment and the positive effects of knowledge sharing can benefit from conflict being successfully avoided or solved.

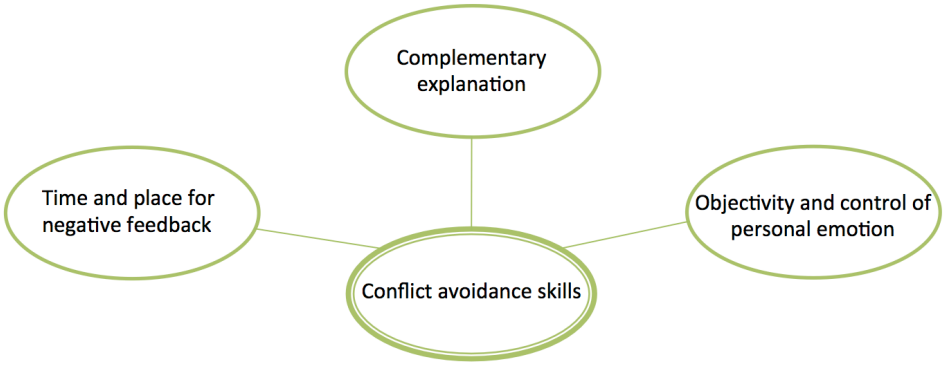


Figure 4.11: Concept map of interpersonal skills – conflict avoidance skills

As presented in Figure 4.11, the sub-category of conflict avoidance skills is composed of three dimensions. The skill of timing and communicating negative feedback is defined as quickly detecting problems from the work and making appropriate decisions on how and when to communicate the corrective or negative feedback to the knowledge receiver. For example, the project manager should be able to detect technical problems within the construction groups' work and explain the problem at an appropriate time i.e. in 'public' or on an individual basis. This helps to avoid quality issues and other negative consequences.

> *"We have supervision people for water circulation, electricity and heating. After detecting problems, they need to immediately communicate with the construction teams. Sometimes the problems need to be solved by redoing the construction work. (PMI – I10 – 178-179)"*

Timing and communicating negative feedback skill should be applied in situations when the project manager detects some problems and needs to share knowledge with the person responsible for the concerns. For example, when a team member makes some mistakes in their work, the project manager needs to have the skill of detecting the problem and deciding whether to discuss this immediately with the team member in private, or to do so in 'public' during a team meeting. This skill can help to identify the right moment for knowledge sharing. More importantly, it also assists the project manager in better managing and coordinating the knowledge receiver, as timing and placing corrective knowledge can affect the team member's attitude and efficiency in receiving and accepting the knowledge.

"There are methods and ways to criticise. For example when there are many people at present, I would not criticise you. If there's something you did wrong, I would point it out personally or privately. (SMI – I13 – 240-241)"

Timing and communicating corrective feedback also involves the project manager clearly explaining his/her position and that of the company he/she works for when sharing corrective knowledge relevant to other companies involved in the project. For example, there are occasional situations where the construction groups require changes in the construction blueprint that are not necessary for the project, but by conducting more work they can generate additional income. When this happens, the project manager from the design institute is usually able to recognise the unnecessary request while the investment company do not have an insight of the situation due to lack of technical engineering knowledge. Thus, the project manager from the design institute should have the skill of sharing this type of corrective feedback with the investor at the right time and in an appropriate way. The relevant quotation is listed below:

"During the construction stage, they would pick on some small details and ask we design institute to make changes. Actually their aim is to save some money, but instead of talking to investor, they directly come to we design institute. If we don't understand what is going on, or with little work experience, we would probably just make the changes. But the changes actually involve costs, which makes investor to pay more money. It is actually a skill or work experience, and also a trouble. Anyway we need to explain to investor well about the situation. Sometimes the information investor receives from the construction team can be that our design has problems. If we make the change, especially being officially approved by our project manager, we would make the design institute to take the responsibility. (TMD – I2 – 197-206)"

The skill of complementary explanation is defined as being able to provide detailed and further explanations about a previous decision or action. This skill is typically applied in two situations. Firstly, in situations where the project manager needs to share complex or corrective knowledge with the receiver while there is a time limitation, but later needs to find the appropriate time to further explain the knowledge previously being

shared. Secondly, in situations where an urgent action is needed but the knowledge receiver does not understand or agree with the knowledge shared by the project manager. The project manager needs to force the receiver to take the required action, but later provide an explanation as to why this action was required. The application of this skill can help the knowledge receiver to better understand the project manager and this contributes towards a knowledge sharing-friendly environment within the project.

> *"We are all human, and if I force something it is normal for them to have the against emotions. What I do is to be patient and explain in details in future... If we conduct according to national regulations, the later-on problems can be less. I can't say to 100% avoid, but the problems appear less for sure. So I need to share with them why I forced them to conduct work in that way, relating to national regulations and standards. (PMI – I15 – 228-234)"*

Conflict avoidance skills also involve being objective and controlling personal emotion, mainly in situations where difficult communication is required or where there is a need to repeat the shared knowledge with receivers. The project manager should be able to control personal emotion, knowing when to be patient and when to hurry the team members to complete their work. This skill assists in building social relationships between the project manager and his co-workers, and thus encourages the receiver to be more accepting of the knowledge being shared.

> *"People have emotions in between, and when this emotion develops they won't make troubles or conflicts. If the relationship between you and them is not good, they might make some trouble on purpose. If the relationship is good, even if there is trouble or conflict they might solve them on their own. (SMI – I13 – 141-143)"*

As mentioned by an interviewee from the design institute in the quotation below, controlling personal emotions sometimes involves being objective and treating team members in a fair way based on objectivities, rather than personal emotions or preferences. This is aimed at avoiding situations where the knowledge receiver holds negative or resistant emotions when receiving knowledge. For example, the project manager from the investing company should be able to treat all construction teams in a rational and objective way, especially when there happens to be conflicts between

different groups. By being rational and reasonable, the project manager can avoid negative and resistant emotions from the group that is not fairly treated and hence increase the cooperation and teamwork performance during knowledge sharing.

> *"Better coordination needs to treat them fairly, without preferring any particular team. Actually we stand for the team with appropriate reasons (when there is problems). For example for product price and quality, although one team purchase a bit higher price but with better quality, we would use the better quality one. (PMI – I15 – 175-178)"*

Despite the importance of social cognitive skills which focuses on the sharing of knowledge from project manager to receiver as discussed in section 4.2.1, merely focusing on this process can lead to insufficient attention on the importance of other factors. Interpersonal skills compose another set of critical skills in facilitating knowledge sharing practice, especially in terms of the co-production and integration of knowledge between the project manager and others.

4.2.3 Strategic orientation skills

Strategic orientation skills are defined as the capability of visioning the project for its long-term success, sharing this with project participants, and aligning them towards the shared purpose. As project managers, their visions of how to deliver the project can affect the other project members' thinking and the long-term success of the project. Therefore, strategic orientation skills are concerned with bridging between and across different organisations in order to deliver the project successfully.

In comparison to social cognitive skills which are primarily oriented to solve a specific issue within the project through sharing, strategic orientation skills are essentially concerned with strategic vision, direction and business development. Compared to interpersonal skills which are focused on improving communications and building positive relations to increase the efficiency of knowledge sharing, strategic orientation skills are concerned with resolving strategic concerns which negatively impact on the sharing of knowledge. This set of skills includes highlighting common interests among project members especially among different participating organisations, reaching a shared solution to the disagreements among participants who have different interests,

and enhancing leadership and decision making towards the project as a whole. The concept map in Figure 4.12 reveals these three dimensions. The combination of these three dimensions enables project managers to better manage and lead the sharing of knowledge from a strategic level.

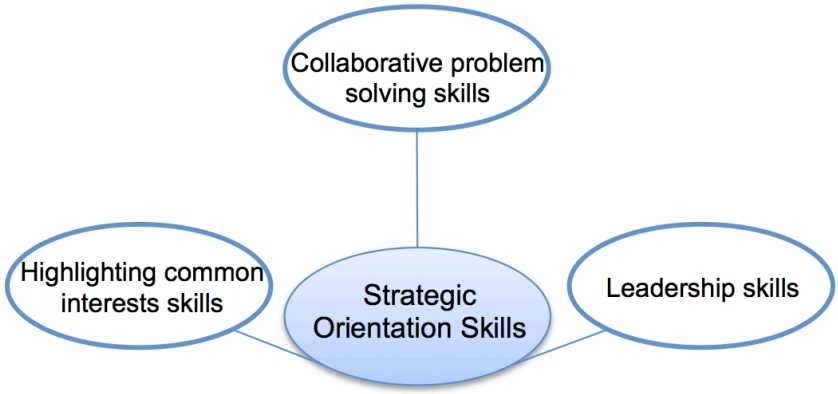


Figure 4.12: Concept map of strategic orientation skills

4.2.3.1 Highlighting common interests skills

Strategic orientation skills are useful in situations where different interests occur among participating members, especially participating organisations, within the project. The occurrence of conflicts of interest can hinder and generate negative consequences in the sharing of knowledge. To address this, project managers should be able to identify and highlight the need of an overall agreement on the common interests and on altering self-interests towards these, and to then share this with those who are involved in the conflicts. This usually requires both practical solutions and political efforts.

Highlighting common interests skills are composed of three dimensions: skill of highlighting team interests which is focused on finding and highlighting the interests of the project as a whole; requirement management skill which is concerned with balancing the requirements and reaching agreements among organisations that have different interests; and compromising skill which enables project managers to make reasonable compromises in order to reach mutual agreements.

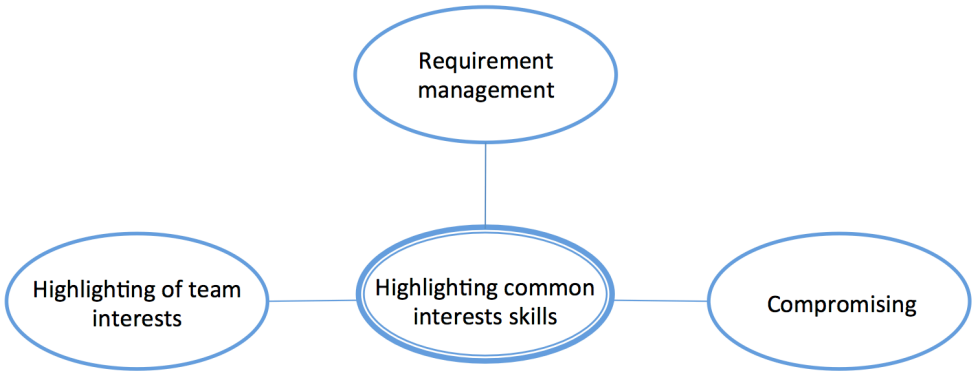


Figure 4.13: Concept map of strategic orientation skills – highlighting common interests skills

The skill of highlighting team interests pertains to enhance relations and working ties within the project team, and build team members' awareness of team working so that each participant presents him/herself as a team member when collaborating and sharing knowledge with others. When confronted with different interests, the project manager needs to be able to identify mutual interests that are the most important for the project team and the development of the project. With the responsibility of leading the team, the project manager should also be able to help members be aware of the integration of different participants and the significant impact of the project on each participant.

> *"For myself, as the person in charge of the team, all I do is for the team. If people recognise this point, they would follow or obey my orders. It is like personal character or charm. All I do needs to be for the team without personal feelings or benefits. Instead of behalf on myself, I represent the team and for the team's benefits. (PMD – I6 – 380-386)"*

Highlighting team interests also helps to increase the familiarity within the project team and cooperation efficiency. This is useful in negotiating requirements and making compromises with different participating organisations, as familiarity and cooperation can create an effective environment for facilitating negotiation and making compromises. This will be further discussed in the following two skills, requirement management and compromising.

Requirement management skill refers to capture, understand, adjust and manage other organisation's needs especially the requirements from the investor, with the aim of reaching an agreement in either fulfilling the requirement or rejecting with explanations. From the knowledge management and sharing perspective, the requirement management process involves project managers capturing knowledge from the requirements, applying their own expertise knowledge in analysing these issues and making decisions, as well as sharing these relevant people within the project. Thus, the requirement management skill is helpful when project managers deal with requirement-related situations and make relevant decisions.

> *"The five-star hotel relies on the points system: there are some items that can add extra points, and when we reach a certain number of points we can be rated as a five-star hotel. In the beginning we were planning to build a swimming pool on the 4th floor, but then decided the level below the ground floor would be better. We were planning to build a fountain and then decided to do something else instead. We went to visit other hotels and made some changes in our ideas such as the style of air conditioning etc." (TMD – I3 – 88-92)*

Requirement management skill is particularly useful for project managers from the design institute and the construction company. This is because requirements are usually specified by the investing company; it is the responsibility of either the design institute or construction company to accommodate these requirements and to negotiate with the investing company about whether to accept and work on the requirements or to decline them. The requirement management skill can also be useful for project managers from the investing company in situations when a new idea has been thought of. It can assist them in critically adjusting their own ideas and sharing this with relevant colleagues.

> *"There were two major changes that the investor raised after completing the construction blueprint, when the project is under construction. The investor had some new ideas, which not because the construction blueprint wasn't good enough. It was simply because they had new ideas about something that we agreed long time ago. They changed their plan and we need to re-design a lot of*

things, which is quite headache. They highlighted the common interests of the project, which is that we all hope the hotel project turns out to be one of the best in our city."(PMD – I6 – 87-94)

The skill of requirement management composes an important dimension of highlighting common interests skills. It is common for different requirements to occur during both the implementation of the architectural design phase and the construction phase of a construction project. The capability of capturing, understanding and managing the requirements is one of the core skills that the project manager should develop and apply, in order to formulate an appropriate solution and achieve expected results. Moreover, being able to understand and respond to the requirements that are raised by another participating company, the project manager can communicate in a way that the concerns and requirements from both his/her company, and the other company, are considered. This makes it easier for the stakeholders to reach agreements in terms of their common interests.

"For some technical issues, when design institute, construction groups cannot communicate well with us, we PMs from the three companies would have a meeting first and then go to the construction field. For example, when the light is designed at the air conditioning place or at the extinguishing protection place, which functioning area should make a concession or change needs to be discussed. (PMI – I10 – 183-185)"

The skill of compromising refers to make reasonable compromises and seek a mutual agreement or solution in situations where the project manager and the knowledge receiver have disagreements or conflicts. It is more commonly applied in situations where the knowledge receiver works for a different company to that of the project manager; it assists the project manager in better sharing of disagreeable or critical knowledge.

4.2.3.2 Collaborative problem solving skills

Collaborative problem solving skills refer to the capability of negotiating and reaching agreements to solutions through the sharing of knowledge, with the aim of improving future knowledge sharing efficiency and successfully completing the project. When a problem associated with different stakeholders appears within the project, it usually

needs to be addressed by different participating organisations collaborating with each other.

Collaborative problem solving skills help the project manager to identify problems, balance the tensions among project participants, and seek a shared resolution. The sub-category of collaborative problem solving skills is composed of four dimensions as shown in Figure 4.14. Problem detection skill can assist project managers in identifying the root cause of the problem, including the differences between expectations and the current situation. The skills of persuasiveness and adherence to regulation are particularly useful in negotiating with other stakeholders, in terms of expressing individual concerns, persuading others and formulating shared solutions. Being able to open to discussion helps the project manager to avoid self-centred thinking when collaborating with others.

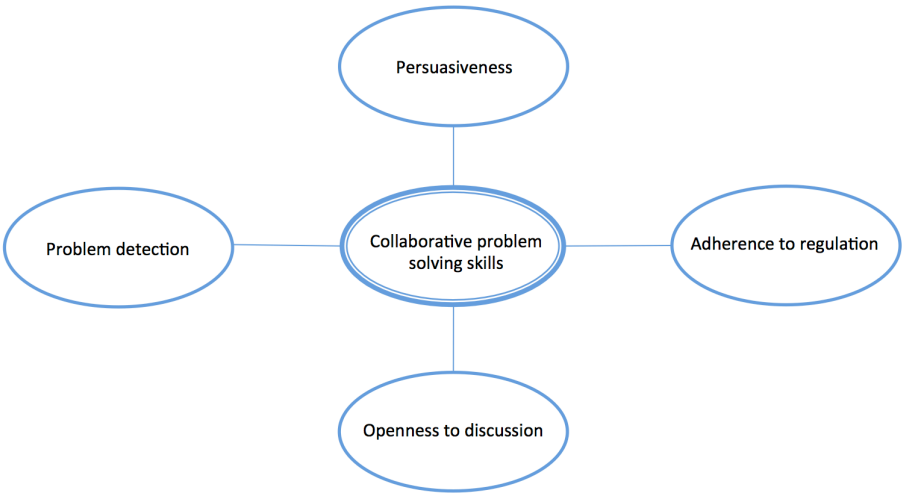


Figure 4.14: Concept map of strategic orientation skills – collaborative problem solving skills

Problem detection skill involves being aware of current problems or potential problems, seeking the root cause of the problem, and identifying the differences between participant's expectations and current situation as the differences can potentially cause disagreements among participants. This skill is the first step in developing an agreed and shared solution among different participants and stakeholders. It is aimed at assisting project managers in detecting existing problems and understanding the reasons why they exist.

Problem detection skill also involves project managers' problem-solving orientation, which is concerned with being aware of problems and thinking of effective solutions (sometimes more than one) for different situations and options in advance, in order to address potential difficulties that can occur during the project. This helps to formulate solutions when sharing the problems and considerations with other participants. For example, the project manager shares common solutions and methods with others in terms of some problems that are likely to happen when conducting the project work.

> *"In every design process, (I) actually am delivering this knowledge in terms of what to do in this case, how to deal that situation etc. No matter it's on purpose or unintentionally, I'm always delivering this type of knowledge. (PMD – I1 – 182-184)"*

Capability in detecting problem is important as it enables project managers to identify mistakes within the work and formulate solutions for them. This process also improves project managers' thinking and concerns for the problem; therefore, it improves the quality of knowledge being shared during problematic situations. To develop and apply this skill, useful methods include to reflect on work experience and summarise some common problematic situations that are likely to happen during a construction project, together with corresponding general solutions. This is related to the analytical skills discussed in Section 4.2.1.1 in terms of reflecting on work experience.

The skill of persuasiveness refers to persuade and convince other people to understand and agree with the value that one wants to express or explain. It is be applied when the sharing of knowledge includes negotiations between the project manager and the knowledge receiver, especially when more than one companies is involved in the sharing. For example, the project manager from the design institute should be able to persuade the investor to agree and appreciate the value and concerns of the design work. Persuasiveness is usually focused on the practical perspectives and actual benefits of the project such as usage of the building and cost saving.

> *"This also involves some strategies. For example for one of the plan, although there are many columns, it is more reasonable in usage. Another thing is with more columns; the overall cost can be low. We need to guarantee safety while*

meeting their requirements. Then we can try best to maximise the functions. (CED – I4 – 143-145)"

When applying the skill of persuasiveness, especially between the design institute and the construction company, the project manager can formulate his/her argument also with the consideration of the fact that the construction market is investor-centred market, i.e. the investing company is the one who invests in the project and selects a design institute and construction company. This helps to make the knowledge receiver more willing to accept and apply the knowledge being shared. For example, when sharing knowledge about the investing company's requirement, the project manager from the design institute will find it easier to persuade construction groups to accept the knowledge and work on the investor's requirement by making them aware of the investor-centred market.

"For design team members, nobody likes changing design all the time. So during daily work, I let them be aware that the construction industry is always investor-cantered industry. The designer cannot always insist to his own opinion; and that investor would come up with his ideas after researching. The investor's ideas are those they think most suitable; reflect the trend of development nowadays. We design people always sit inside office, so to some extent the thing we design may not follow closely to the trend of development. (PMD – I6 – 147-157)"

In situations where there is a need to share complex knowledge about a specific issue of which there is a national regulation, the project manager can refer to the regulation to make sure the receiver follows the knowledge being shared. In these circumstances, the skill of adherence to regulation is useful in formulating collaborative solutions to problem solving. It makes complex knowledge sharing more efficient (e.g. when a lot of complicated engineering knowledge is involved) and helps to guarantee the formulation of solutions, as the construction laws and regulations are non-negotiable requirements that have to be implemented during project work.

"Sometimes we cannot explain too much with them, so we just say that these products are out-of-use that the regulation claims they cannot be used anymore. ... It can be safety concerns or hygiene concerns, some negative issues.

Sometimes the more we explain, the less he understands. So we just tell him that it's banned from usage. (TMD – I3 – 186-193)"

Adherence to regulation skill sometimes is seen as a 'forceful' type of solutions for solving problems. This skill is usually applied in combination with the skill of compromising (see Section 4.2.3.1) i.e. insisting to follow the principles of the regulation when negotiating with others and making compromises.

"We cannot make sacrifices and not follow design principles or regulations. We have our own principles and bottom lines. In the condition of obeying these lines, we can try to fulfil their (investor) requirements to solve the problems. But they cannot come up with unreasonable requirements and go against the principles. The principle here refers to the items in law or regulations - they are all written there. These are our bottom lines that cannot be crossed; otherwise there might be legal issues. Under this condition, we always try our best to fulfil investor's requirements and solve their problems. But if there are things cannot be fulfilled or solved, we have to let investor to give up their idea. (PMD – I1 – 281-286)"

Openness to discussion is focused on avoiding self-centred attitudes, delegating opportunities to express ideas to all project participants and providing relevant supports. It is necessary for the project manager to be open-minded and receive opinions from different organisations and team members. The openness to discussion skill supports all participating organisations and project members to express individual concerns and viewpoints, which helps to formulate a shared solution to solve the current issues. Being open to discussion also helps the project manager to create a positive environment for communicating and knowledge sharing, by generating opportunities for individuals to express their opinions.

"Don't always be self-centred. A PM must always discuss with team members. If you have the knowledge, you should cooperate with the people … Human factor would be the atmosphere of the team. The team needs to be united and tolerate each other in terms of personal emotions or interests. … An ideal PM need to have good knowledge, open-minded, with great goals. I think this type of people is suitable in management team. (PMI – I9 – 253-257)"

To formulate agreed and shared solutions that benefit and satisfy different participating organisations, it is vital for the project manager to be open-minded and to not hold any 'prejudices'. This therefore, contributes to the development and application of collaborative problem solving skills.

4.2.3.3 Leadership skills

Leadership skills refer to the ability to establish vision and effectively make decisions in order to align others towards the common purpose of sharing knowledge, and to be able to empower and inspire others to achieve success in knowledge sharing and in the project. Differing from common interests highlighting skills and collaborative problem solving skills, leadership skills highlight the management and leading role of project managers in order to guarantee the success of the knowledge sharing and the project.

Leadership skills are composed of four dimensions as shown in Figure 4.15. The skill of overall control helps the project manager to gain a generic and comprehensive view of the whole project. Effective decision making enables the project manager to make appropriate decisions in order to guarantee a smooth knowledge sharing process. Balancing hard and soft approaches and building personal authority are the supporting skills which help to improve effectiveness when applying leadership skills.

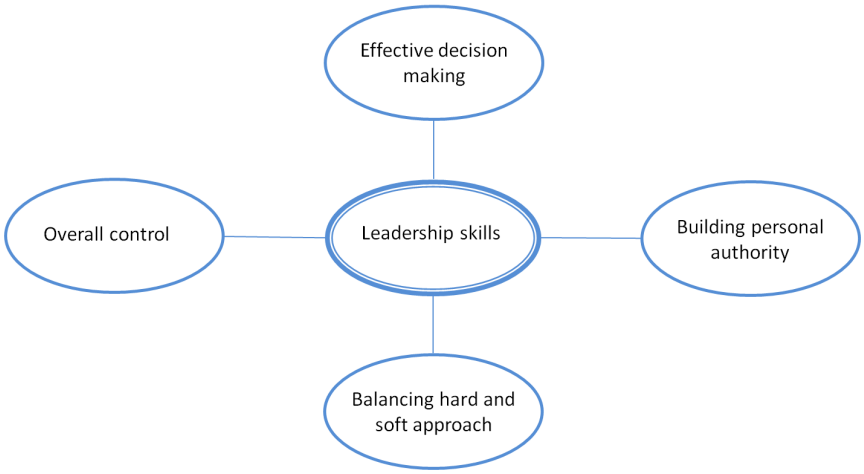


Figure 4.15: Concept map of strategic orientation skills – leadership skills

The skill of overall control is defined as the skill of controlling the project from a general level, including its timeline, the different functional areas involved and resource allocation. This skill assists the project manager in obtaining a comprehensive view, leading the development of the project, and sharing relevant knowledge with the appropriate groups of people. It is sometimes associated with personal work experience and character, and guarantees the efficiency of knowledge sharing at a generic level.

> *“I think it's about overall-control. The project manager needs to have this skill to be good. For example in arranging events, how can this project be conducted and who can be the person to conduct. (TMD – I3 – 447-449)”*

Being able to take overall control of the project helps the project manager to manage and coordinate processes, participants and knowledge sharing. This enhances the project manager’s lead position within the project; effective overall management and coordination also improves the project members’ willingness to communicate with and receive knowledge from the project manager.

The skill of effective decision making is applied in the situations where the project manager is confronted with different options. To make effective decisions, a common strategy the project manager usually adopts when he/she is unsure about a situation is to be flexible and avoid making immediate decisions. For example, when the investing company requires some changes to the architectural design, sometimes the project manager from the design institute cannot be sure whether this is applicable. In this type of situation, the project manager should be flexible and not reject it immediately. Instead, he/she should have a discussion within the design institute to decide whether the requirement can be accepted and implemented, and then communicate with the investing company. This is to avoid the situation of a decision being made and then, after conversations, being overturned; this can negatively affect the trust that exists from the investing company towards the design institute and thus influence the knowledge sharing efficiency between the two companies.

> *"It happened earlier that because the limitation of regulations or somewhere else, this (investor's requirement) can definitely not be applied. But with the increasing*

of working time and experience, we tend to reply that technically it can be changed, but needs to get approvals and make changes. In other words, we cannot reply a 'no' answer at the beginning when we are not sure. (TMD – I2 – 122-125)"

Effective decision making skill is also important for project coordination. Project managers need to effectively coordinate different members, including different construction groups which are outsourced by the construction company. Sufficient decision making can help the project managers to arrange appropriate coordination among the project members, and to share the reasons in terms of why the work is arranged in such ways. This skill is particularly useful for project managers from the investing company, it assists them in organising and directing the order of construction work as well as in creating a positive environment for the knowledge sharing with the construction groups. During the coordination, the most important consideration for project manager is to not let one group affect other groups' work.

"We have a plan in terms of how each construction team enters the construction field and how to arrange it. This is a very complex process, for example for a small part of the project, how many people are required and how many days does it need to complete; after which construction team does this one need to enter; before which construction work does this one need to be completed - it is a very accurate process. When planning it, for example there might be ten construction work need to be undertaken at the same time. These ten works all have their restrictions and limitations such as which one needs to be done ahead of or after which one - these are set knowledge. But we need to coordinate the time, such as after construction work A, work B enters the field; B entering the field doesn't affect other construction works etc. This is the biggest principle. (PMI – I8 – 129-136)"

The skill of effective decision making is relevant to requirement management skill discussed in Section 4.2.3.1. Requirement management skill is focused on the situations where requirements are identified in the project, assisting the project manager in capturing and understanding the requirements as well as in applying his/her professional knowledge to the requirements before making decisions. This helps to improve the development and application of effective decision making skill.

The skill of building personal authority refers to gaining personal dignity and reputation in front of team members and other companies, especially in front of the members with technical knowledge and skills as they tend to have a high opinion of their specialised area of work. This skill helps the project manager to develop the impact of his leadership, making knowledge receivers more willing to listen and attempt to understand the knowledge he/she shares.

> *"My style in work is that I am the boss. Usually for construction, for example time length limit or team goals, I tend to be bossy. Construction industry is not like politics or teaching primary students. They construction teams are all with their techniques. If PM doesn't have personal prestige, it sometimes can be difficult for them to listen to you. It's difficult to manage the technical people. So usually I use 'high pressure' policy that I am the boss, and you need to figure out ways to complete the goals I set. (PMI – I10 – 220-223)"*

Building personal authority also involves helping knowledge receivers to realise their responsibilities, and the importance of meeting them, in an appropriate manner. Being reminded about responsibilities encourages knowledge receivers to have a more serious attitude and pay more attention during informal knowledge sharing. In particular, when project managers need to share knowledge with team members from another company within the project, the skill of building personal authority can assist them in addressing situations such as team members not paying attention to the communication.

> *" My way is to pressure. For the construction teams, sometimes when you talk to them politely, there is no problem. But sometimes when you tend to be quiet or shy, they don't follow you. Because for the construction teams, they tend to have some 'guanxi' and personal relationships and have their own techniques. Sometimes they don't share things with you and don't follow you either. In this case I have to restrict them via materials or fees. Without restriction right it can be very difficult. (PMI – I11 – 230-234)"*

The skill of balancing hard and soft approaches refers to managing and controlling the balance between hard methods and solutions and the soft attitudes; ‘hard’ in the way of strictly following science and regulation, and ‘soft’ in a way of more relaxed attitude.

This skill is particularly useful for project managers from the design institute and construction groups when they need to share knowledge with the investing company. For example, when some of the requirements from the investing company cannot be addressed by the design institute, the design project manager needs to share relevant reasons and knowledge. By a well-balanced hard and soft approach, the project members from the design institute will be able to explain the scientific reasons for rejection and meanwhile, make the investor aware that the design institute works for the purpose of serving the investor and the project. This encourages the investing company to be willing to understand the knowledge shared from the design project manager.

> *"I think I cannot be simply always hard or simple. As the role of a designer, I need to let them first respect science. Also I need to let them know that I'm working and serving for them, for their good; therefore sometimes I need to low down a bit. A: So be balance? B: Yes, it's like forward and backward. I need to use hard approach when necessary, and then low down a bit and let them know I'm working for them. (PMD – I6 – 366-372)"*

The soft approach also involves informal reward such as oral praise and being treated to dinner, which is usually given to the members who complete their work on time and to a high standard. This helps to motive project members to engage with the knowledge being shared by the project manager, and also share their own opinions, in order to complete their tasks properly.

> *"If the work is completed - usually we have time length limit - we have rewarding policies... Sometimes we also reward through money --- different ways. For different designs and situations, we need to have different solutions. (PMI – I10 – 26-27)"*

To briefly conclude, strategic orientation skills are focused on the role of the project manager with regard to higher-level responsibility of representing different participating organisations and interests. The development and application of strategic orientation skills assist the project manager in identifying solutions especially when conflicts occur between organisations and in guaranteeing the smoothness and effectiveness of knowledge sharing.

4.2.4 Summary and theoretical implications

This section responded the second research objective, which is also directly related to the main research question of what skills contribute to effective knowledge sharing for project managers in construction projects. Three sets of skills are identified from this research; they are social cognitive skills, interpersonal skills and strategic orientation skills. These three sets of skills, together with the detailed components under each set, are summarised and presented via the concept map as shown in Figure 4.3. Social cognitive skills are focused on perceiving, translating and interpreting, i.e. perceiving situations and other people, translating different understandings, and interpreting the project manager's individual knowledge – which enables and accelerates reaching shared meanings among project participants. Differing from social cognitive skills which directly address the sharing process, interpersonal skills are concerned with generating a 'soft' environment via improving interactions and building positive relations inside the project, which from the social interaction and interpersonal relations perspective, guarantees a smooth process in knowledge sharing. Strategic orientation skills enable the project manager to envision the long-term success of the project and assist in sharing goal related knowledge, and in addressing knowledge sharing issues via leading and collaborating.

The finding also illustrates differences in 'levels' in terms of the applications of the skills. Strategic orientation skills, presented at the top of the triangle in the concept map, deal with cross-organisational level of knowledge sharing issues. When the situations are not merely sharing different knowledge but also involve differences and conflicts in interests, especially among different participating organisations, there is a need to reach common goals and interests to solve the problems collaboratively. Social cognitive skills, placed at a lower level from strategic orientation skills in the concept map, are more often applied when the differences in knowledge are at an individual level rather than when interests or conflicts are involved. Focusing on analysing situations and reaching shared understandings among project members, the social cognitive skills set tends to deal with more specific issues that occurred within the project and thus tend to be more frequently applied compared to strategic orientation skills. Interpersonal skills are placed at the same level with social cognitive skills, as this category of skills is concerned with creating a positive and friendly environment for

knowledge sharing within the project. This parallels with and can help the application of social cognitive skills. Despite the fact that interpersonal skills can also assist the application of strategic orientation skills, they tend to be more useful in generating a positive knowledge sharing environment when there is no conflict of interest between participants.

The development and application of the three sets of skills are interconnected. Firstly, some sub-category skills can overlap and be inter-related with other sub-category skills that are fall under a different main category. For example, the clarification and articulation skills under the category of social cognitive skills, and the interpersonal communication skills under the category of interpersonal skills, are both concerned with expressing individual ideas and knowledge when sharing with others. The application of both these two skills can directly influence the communication processes and knowledge sharing effects. However, they concentrate on different perspectives: clarification and articulation skills are focused on the project manager organising and structuring the knowledge before expressing to the receiver, while the interpersonal communication skills highlight the importance of understanding the receivers and responding to them appropriately. Similarly, the conflict avoidance skills under the category of interpersonal skills, and highlighting common interests skills under the category of strategic orientation skills, are both applicable for addressing conflicts in knowledge sharing. The differences lie in their main focuses: interpersonal skills are concerned with creating a positive knowledge sharing environment; conflict avoidance skills are focused on avoiding misunderstandings between individuals and negative emotions; strategic orientation skills are associated with conflicts of interests between organisations and stakeholders. Highlighting common interests skill assists project managers in solving conflicts by identifying and emphasising the common interests among the participants. Secondly, because of the overlap and interconnectedness, the three sets of skills need to be developed, combined and applied together by project managers in order to share knowledge efficiently throughout the project.

The identified skills are also open to different interpretation and emphasises according to various organisational position within the project. For example, project managers from the investing company tend to emphasise the importance of leadership skills, as

they play more coordinating roles in the project than their counterparts from the other two companies. Project managers from the design institute highlight more on interpersonal skills due to the fact that they need to communicate a lot of implementation knowledge; this involves sharing technical knowledge with members within the design institute with an engineering background and members from the investing company who tend to know less technical knowledge.

The categories of skills – linked to the three phases of a construction project – do not strongly illustrate which skills are particularly useful for which stage of the project. This is different from the knowledge domains discussed in the previous section; the main reason being, that the identified knowledge domains are focused on the knowledge itself that needs to be shared. As the project involves, the emphasis on required knowledge and the frequency of sharing with regard to different knowledge domains change accordingly. The skills, however, are more focused on assisting the sharing of knowledge throughout the three phases. Another reason is with regard to the relationships between the skills and knowledge domains. Analysed from the findings, each set of skills can assist the project manager in sharing more than one knowledge domain. As different knowledge domains can be more useful for different phases, it is difficult to specify the skills sets to particular phases. This will be further discussed in the first section of the discussion chapter. Therefore, the findings in this research revealed that the application of combing social cognitive skills, interpersonal skills and strategic orientation skills is important and necessary for each stage of the project.

4.3 Summary and implication of findings

This chapter presented the main findings of this study. The two sections have sequentially responded to the two objectives: 1) to identify and explore different domains of knowledge that project managers need to share in their practice in the construction industry; 2) to identify and explore different skills that support project managers to share the knowledge domains.

The findings suggest five knowledge domains that need to be shared: knowledge of risk; knowledge of planning; knowledge of implementation; knowledge of people; and strategic and operational knowledge for project business. The domains served as a

logical step leading to the identification and analysis of skills that contribute to knowledge sharing; they are categorised into social cognitive skills, interpersonal skills and strategic orientation skills.

The identification and discussion of knowledge domains illustrated the dynamic and interactive nature of knowledge sharing during a construction project lifecycle, as presented in Section 4.1.6. Apart from project managers sharing individual knowledge, the processes of sharing knowledge pertaining to different domains can also involve discussion between project managers and knowledge receivers. Such discussions are not merely about a project manager's own knowledge being understood, but more importantly, shared meanings and solutions being adopted. The three sets of skills facilitating knowledge sharing focus on different perspectives when being applied, as indicated in Section 4.2.4. To deliver successful knowledge sharing, project managers need to develop and apply a combination of these three skills sets appropriately.

The processes in identifying and analysing the knowledge domains and the skills have revealed important relationships between these two entities. The identification of knowledge domains serves as an important path to the investigation and discussion of skills that contribute to knowledge sharing, as the domains are where the skills need to be applied. A strong link exists between the skills and the knowledge domains, as certain skills can be particularly useful and need to be applied in sharing certain knowledge domains. This indicates the importance of further establishing and discussing the relationships between the knowledge domains and the skills that contribute to knowledge sharing. This is presented and discussed in the following chapter.

Chapter 5: Discussion

5.0 Introduction

The aim of this research is to investigate different skill sets that can be used by project managers in their knowledge sharing practices. In this chapter, the results presented in the Chapter 4 Findings are brought together and discussed with the relevant literature, with the aims of conceptualising the findings of this study and understanding the position of their contributions within the broader context of this research.

This chapter begins by exploring and discussing the relationships between the identified knowledge domains and the skills. This is followed by presenting and discussing an integrative framework that summarises the knowledge domains, the skills and the relationships between them within the context of a construction project. In the third section, the knowledge domains, skills facilitating knowledge sharing, and the integrative framework are related to existing studies and relevant models. The final section summarises the discussion chapter.

5.1 Relationships between knowledge domains and skills that contribute to knowledge sharing

This section provides an in-depth discussion about the relationships between knowledge domains and skills that contribute to knowledge sharing. In Chapter 4 Findings, knowledge domains and skills are presented separately, as they respond to the two research objectives in sequence. In fact, in most literature, knowledge domains and skills facilitating knowledge sharing remain as separate and unconnected entities. However, the interview data in this study clearly points towards their interrelationships. The purpose of this section therefore, is to explore and conceptualise these relationships in the context of the three-phase construction project.

The section begins by presenting each sub-category of the skills with their relevant knowledge domains and discussing the relationships between them. It specifically examines the skills in terms of which knowledge domains they each can be applied to, how they operate, and why a relationship exists. The discussion is supported by the data collected in this study as well as relevant literature. At the end of this section, the

implications of the relationships are summarised and discussed, both from a conceptual and managerial perspective.

KS skills Category	Sub-category of KS skills	Knowledge on risk	Knowledge on planning	Knowledge on Implementation	Knowledge on people	Strategic and operational knowledge
Social Cognitive Skills	Analytical skills	•	•	•		
	Clarification and articulation skills		•	•		
	KS channel and tool selection skills	•	•	•		
Interpersonal Skills	Interpersonal communication skill			•	•	
	Skills of building and sustaining positive relations			•	•	•
	Conflict avoidance skills			•	•	
Strategic Orientation Skill	Highlighting common interests skills		•		•	•
	Collaborative problem solving skills			•		•
	Leadership skills		•	•	•	•

Table 5.1: Relationships between knowledge domains and skills that contribute to knowledge sharing

The relationships are summarised and presented in Table 5.1. Each of these relationships is important in terms of the sharing of knowledge and the application of skills; each is consistent with the interview data in the present study; and each can be adapted to particular situations that project managers need to address. Overall, social cognitive skills are useful in sharing the knowledge domains of risk, planning and implementation. Interpersonal skills can be applied to share the knowledge of implementation and knowledge of people, with one dimension also being useful in sharing strategic and operational knowledge. Strategic orientation skills can assist project managers in sharing business strategies and operations knowledge, as well as, knowledge of planning, implementation and people.

5.1.1 Social cognitive skills

5.1.1.1 Analytical skills and knowledge domains

Analytical skills are useful for project managers to share knowledge about risk. As presented in Chapter 4.2.1, one dimension of analytical skills is focused on the

capability of analysing different factors within a situation. This enables project managers to be aware of potential risks embedded in the project, such as those in the design, the impact of current work on long-term sustainability of the building, and the consequences of hidden mistakes. It also helps project managers to articulate and share the risk related knowledge such as what the risk is and why it exists.

In particular, one property of analytical skills, being able to think in a cross-functional and integrational way (see Section 4.2.1.1), assists project managers in analysing risks associated with different functional areas for the design and construction work, and sharing these comprehensively with others. Risk in the construction industry refers to the likelihood of the occurrence of a definite event or factor, or combination of events and factors that can occur of the construction process to the detriment of the project (S. Q. Wang, Dulaimi, & Aguria, 2004). This explains that being able to think in a cross-functional and integrational way helps the project managers to analyse factors and events, and therefore better predict the risks embedded within the project. The dimension of pro-active thinking (see Section 4.2.2.1) and logical thinking (see Section 4.2.1.1), under analytical skills, can help project managers to analyse potential threats in advance and thus guarantee the timely sharing of potential threats with others. As exemplified by an interviewee from the investing company as quoted below, the pro-active and logical thinking can raise project managers' awareness of potential threats embedded in the current work.

> *"When construction teams come up with questions or doubts, we (investor) need to consider proactively, such as what are the influences for adopting this solution or that solution. Then we (investor PM) need to share with our senior manager and receive his agreement, and then share with the design institute. (PMI-I8-59-62)"*

The dimensions of 'learning from written materials and similar projects' and 'experience reflection and combination' (see Section 4.2.1.1) of analytical skills can also help project managers to share knowledge about risk. From learning the written materials, visiting similar projects, and reflecting on personal work experiences, project managers can extract the relevant knowledge to analyse the current situation in terms of its potential threats, and share accordingly with project members.

"One is that you must have enough storage of knowledge, so that you can acquire enough cases and materials and then be able to share. For example for some real case projects, you need to know about it and have it in mind, so that you can better share. (PMD – I6 – 347-349)"

Through investigating different factors within a situation, analytical skills enable project managers to be aware of potential risks embedded in the project, and to perceive the thinking of project members. Through the analysis and reflection processes, project managers can also obtain enriched knowledge to share the risk related issues such as what the risk is and why it exists.

Analytical skills are also useful in sharing planning related knowledge. They can enable project managers to formulate plans from an integrational and comprehensive perspective, via analysing different factors that can affect the implementation. Specifically, the dimension of pro-active thinking (see Section 4.2.1.1) helps project managers to be aware of the results or consequences of a plan. This is useful in formulating and sharing the plan comprehensively and in making others understand the plan. Analytical skills also contain logical thinking (see Section 4.2.1.1), which can help project managers to rationalise the adoption of a particular plan in terms of its feasibility, requirement and situational analysis.

Analytical skills also contribute to share knowledge of planning through enabling project managers to analyse and learn from similar projects, reflecting on individual work experience in terms of planning issues, and applying these to the current work. For example, revisit experience to avoid reconstruction and to offer purchasing suggestions. Situated practice often involves reflection on and experimentation with the individual's previous knowing (Orlikowski, 2002); the knowing can help to improve the current practice via project managers reflecting on their previous experience to make better plans and sharing the plans with project members.

"For example at the beginning, we went to other cities to study in terms of fixture styles. After that I shared my knowledge and experience with other PMs in charge of structure, facilities, interior and exterior fixture... For the hotel especially during preparation, many people go through wrong or difficult ways. For example,

Wanfeng (another five-star hotel in Xingtai City) went through many difficult paths due to lack of work experience... It is like we learn many things from their cases... It can be counted as work experience, or failure lessons. (PMI-I13-172-173)"

Consistent with Hwang and Ng's (2013) findings, analytical skills are found to be one of the most important skills required to address planning challenges, especially when more time is required and when a balance needs to be achieved to ensure some alternatives.

Implementation knowledge can be better shared via project managers applying analytical skills, especially via revisiting previous experiences and similar resources to suggest implementation solutions. As exemplified by the quotation below, visiting and learning from successful projects that are similar the current project can assist project managers in obtaining implementation knowledge and in sharing the relevant knowledge with team members.

"For example the extractor fan should be with no noise at all, which we cannot find the style in Xingtai City. We didn't know how to construct that either. So we went to big hotels in Beijing to visit and learn... We always learn and practice, accumulating experiences." (PMI – I11 – 306-308)

The project manager's professionalism can be constructed in practices when implementing the work; the knowledge in practices is widely recognised as a resource to be deployed when working on complex problems (Edwards & Daniels, 2012). Analytical skills enable project managers to analyse previous practices, and formulate the implementation knowledge for the current situation. Therefore, their implementation knowledge can be shared in a more comprehensive and vivid way by providing previous practice examples. In situations where different functional areas are involved during the design and construction phases, the dimension of cross-functional and integrational thinking in analytical skills is particularly useful in formulating and sharing relevant knowledge.

5.1.1.2 Clarification and articulation skills and knowledge domains

The skills of clarification and articulation can assist project managers in sharing their knowledge about planning. Especially, via clarifying advantages and disadvantages of a plan, the project managers can make the shared knowledge clearer and easier for others to understand. This also helps the project team members to know why a decision about a plan has been made. In addition, in planning different work time frames for different stages, specifying and clarifying the amount of work can help project managers to share procedures and make better decisions about the time frame.

> *"For example the time, two weeks are not enough. Then I need to explain to him in details: these are all the work I need to conduct, this part takes X time and that part takes Y time. After adding all the time, even including extra hours after office, I cannot finish it within this amount of time. (PMD –I6 – 94-97)*

Clarification and articulation skills are also useful in sharing implementation related knowledge. The dimension of clarifying advantages and disadvantages of a solution or a situation can help the knowledge receivers to understand the implementation knowledge in a more comprehensive and in-depth manner. The dimension of making abstract knowledge concrete and understandable can also contribute to explain technical knowledge and apply the knowledge in implementation work.

> *"If investor doesn't understand, we would draw the regulations and explain the technical knowledge. Make things concrete and detailed. Sometimes through only saying it doesn't work according to regulations, the investor won't understand. So sometimes we draw the regulations and use regulations to explain. (TMD – I2 – 222-227)"*

The dimension of demonstration (see Section 4.2.1.2) can help others to understand the knowledge that the project manager shares, as demonstrations can help to visualise the implementation knowledge in a more vivid way and assist others to understand by being shown 'how to do'. Additionally, the capability of simplifying technical knowledge (see Section 4.2.1.2) is useful for situations such as when the investor does not understand specific engineering knowledge; project managers can simplify the knowledge via drawing on papers and explaining in non-technical ways.

5.1.1.3 KS channel and tool selection skills and knowledge domains

Being able to select appropriate knowledge sharing channels and tools can help project managers to share their knowledge about risk. For example, using the space at the construction site to describe potential problems within the design or construction work can help others better understand what the risks are.

> *"Sometime we would, for example make a cross section view and see in real construction, can the facilities be arranged or not. Then the manager would draw a draft and arrange it on the draft. Sometimes we different functioning areas are asked to put together our design pictures and analyse together about small issues such as direction of tubes. This is to avoid big potential problems in actual construction. (TMD – I3 – 112-116)"*

The capability of selecting channels and tools also helps to share knowledge about planning. During the first phase of project conceptualisation and the second phase of architectural design, project managers from the investing company and the design institute need to communicate and share individual opinions about different plans. When there are concerns or disagreements about a specific plan, especially regarding the usage of a certain space, the capability to use blueprint and actual site can help project managers to explain the planning related knowledge and as a result, the team can make better decisions. Furthermore, in this process, the blueprint functions as a boundary object that assists in the sharing.

> *"When we share this knowledge, we ask him to go outside the space to feel, for more than 1000 square meters with that height, he can feel it's safe but there is no extra effect. Then we try to persuade him and he would be more willing to make changes for us. (PMI – I11 – 124-126)"*

Capabilities in selecting knowledge sharing channels and tools are also useful in helping project managers to share implementation knowledge with others. Appropriate channels and tools can assist project managers during the process of sharing and helping others to better understand the knowledge. For example, using the blueprint properly during knowledge sharing can save many efforts in explaining, because visualisation helps the receiver to understand the knowledge. Besides, IT proficiency (see Section 4.2.1.3) enables project managers to use relevant design and construction

software to share implementation knowledge in a timely manner. The relevant software is an efficient tool in stimulating different functional areas when changes occur with team members.

5.1.2 Interpersonal skills

5.1.2.1 Interpersonal communication skills and knowledge domains

Interpersonal communication skills can assist project managers in sharing implementation knowledge through increasing the efficiency of communication between themselves and other participants. Particularly, the dimension of being able to respond quickly (see Section 4.2.2.1) can help project managers to develop capabilities in understanding, thinking and reacting to situations. Therefore, their knowledge about implementation can be shared timely with project participants without delays or misunderstandings. Another two dimensions, understanding knowledge receivers and selecting appropriate receivers (see Section 4.2.2.1) to share knowledge with, are also useful in sharing implementation knowledge.

> *"One is through explanation, and the other is after explanation he needs to reflect these on design pictures. Then I can tell whether he understands or not through reading his design picture. (PMD – I1 – 161-168) "*

Knowing the needs of receivers enables project managers to share the implementation knowledge with them, in a way that they are willing to listen and accept. Selecting appropriate receivers is helpful for situations where an urgent or critical implementation-related problem needs to be discussed and addressed, as appropriate receivers can understand the knowledge being shared more efficiently.

Interpersonal communication skills can facilitate knowledge sharing more effectively through increasing employees understanding; more frequent and effective communication between managers and staff members is important in improving the knowledge-sharing culture of the work setting, especially during meetings and debriefing sessions (Israilidis, Siachou, Cooke, & Lock, 2015).

Interpersonal communication skills can also help project managers with their knowledge pertaining to people. This is mainly reflected in assisting them in gaining

and enhancing their knowledge about people rather than the sharing. Communicating with the participants within the project can be viewed as a process by which project managers gain their understandings towards the people with whom they interact. For example, the dimension of understanding knowledge receiver can help project managers to gain and accumulate their knowing about project team members. As exemplified by an interviewee from the design institute, when the project manager interacts with others in order to know whether the shared knowledge is being understood, the project manager again improves their own individual knowing about team members in terms of how they tend to react in different situations.

> *"One is through explanation, and the other is after explanation he needs to reflect these on design pictures. Then I can tell whether he understands or not through reading his design picture. Through this process, I also gain the knowledge about that person. For example, what he tends to react if he understands and how he behaves if he doesn't understand the knowledge. (PMD – I1 – 161-169) "*

Besides, the dimensions of being able to understand knowledge receivers and being sensitive to their knowledge needs can help project managers to share knowledge about people. For example, when the project manager realises that a particular area of knowledge is useful for a team member but the knowledge exceeds the project manager's individual knowledge, the project manager can share his or her knowing about other people who can potentially help with the situation.

5.1.2.2 Positive relation building and sustaining skills and knowledge domains

Building and sustaining positive relations is useful in creating a people-friendly environment for knowledge sharing. Building and sustaining positive relations is useful for project managers to share implementation related knowledge. Social interactions are dynamic in nature, especially with temporal characteristics in terms of duration and time order (Pirzadeh & Lingard, 2017), which contributes to share implementation knowledge in a dynamic and timely manner. Firstly, positive inter-relations between participants within a project can contribute to the timely sharing of knowledge; project participants tend to communicate with each other more often in terms of specific implementation issues. Project managers therefore can share implementation knowledge with others more effectively.

Secondly, and more importantly, building and sustaining positive relations can assist project managers in obtaining implementation related knowledge that is of a strong tacit nature, especially from external cooperating partners or organisations. For example, when cooperating with material suppliers, a strong and positive relation with the supplier can encourage them to provide more insight knowledge regarding the materials, recommendations, and ways of saving investment whilst using products of good quality. For these types of insightful knowledge, it is usually not the responsibility of the supplier to inform the project managers; however, via building and maintaining good relations, project managers can obtain useful insight knowledge from the supplier and share this with relevant project participants.

> *"I (investor) need to treat them (supplier) as friends. It must be like this. Otherwise it can be troublesome that he doesn't tell details. For example every time when the supplying person comes, I would have dinner with him as I can sign the dinner on behalf of the company. But I need to treat him dinner as friends, and in that way he can have conversations with me and help me with many ideas and suggestions. For example even for wearing green colour clothes, there are eight types of green, which green colour exactly it should be, he would not tell. But if you are friends with him, he would provide you colour samples with explanations. Interior fixture is quite soft, including wallpapers and curtains, he can provide you samples with appropriate recommendations. If you don't make friends with him, he won't provide very insight information, and can receive commission or kickbacks from suppliers for the materials. ... So this is good for our construction and our investment." (PMI – I11 – 236-244)*

As well as creating a positive environment for knowledge sharing, another purpose of positive relation building and sustaining skills is to enable project managers to access knowledge sources from external counterparts and experts. This is similar to the external-oriented strategy as defined by (Bierly & Chakrabarti, 1996): individuals act as a boundary spanner to bring in knowledge from an outside source through knowledge acquisition and social relations, and the knowledge is then shared inside the organisation. In this sense, building positive relations with external experts or counterparts can help to develop a broader knowledge base and to increase the

flexibility of the project manager in terms of choosing knowledge sources. This also assists the project manager in sharing knowledge about people.

Positive relation building and sustaining skills can also help project managers to share knowledge about people. The skills enable project managers to understand and retain positive relations with co-workers, through which they also obtain and accumulate individual knowledge about them. In particular, the dimension of expanding social relations (see Section 4.2.2.2) enables project managers to expand individual social networks and develop interpersonal relations with experts from other companies in the construction industry. This enhances their knowledge about external experts, which is useful when sharing and directing project participants to such people for consultation.

> *"We looked for experts from outside and communicate with them. After communication and learning, we shared our knowledge to team members and guide them. We try to be good and make the project with little regrets. (PMI – I11 – 309-311)"*

Positive relations, with both internal project members and external experts, are also useful in sharing knowledge about strategic and operational knowledge for project business. Internally, positive relations play an important role in social interactions with co-workers; such social interactions can be a foundation that underlie strategic discussion and decision making during the project (Pirzadeh & Lingard, 2017). Therefore, positive relations can assist project managers in sharing strategies and operations more openly and with harmonious means, which encourages the flow of strategic and operational knowledge.

> *“There are some issues in the project that I have not dealt with before and don't know how to. The PM knows more than me, and she would state that there was previously a similar project and I can ask the relevant person who was involved with that work. So the PM would provide a way and method, then I would solve the problem accordingly.” (PMD-I3-335)*

Externally, positive relation building and sustaining skills help project managers to acquire the industrial related knowledge from external experts and

counterparts, as exemplified by the quotation above. This is valuable and useful for strategic decision making, especially in terms of how to better operate the project from an investment and budgeting perspective. External knowledge acquisition and learning enables firms to view some issues, especially those around strategic development, from different perspectives; only seeking and sharing knowledge internally sometimes can be limiting due to the established organisational routines and biases (Bierly & Chakrabarti, 1996).

5.1.2.3 Conflict avoidance skills and knowledge domains

Conflict avoidance skills are useful in sharing knowledge pertaining to implementation, especially when some disagreements or criticising knowledge are involved during the project implementation phase. Conflicts with other project team members are common and almost unavoidable in construction projects (Hwang & Ng, 2013). The conflict avoiding in this study refers to conflict prevention through creating a positive working environment and be considerable for each other. Also, project managers need to be able to effectively manage conflicts without affecting the progress of the project (Hwang & Ng, 2013).

The dimension of timing and placing for negative feedback (see Section 4.2.2.3) can assist project manager in identifying an appropriate time and location to share negative feedback with others. For example, the project manager needs to decide whether the knowledge needs to be shared at a public meeting or in private, so that the feedbacks can be shared in a suitable manner. This also helps the receiver to understand the knowledge in a more comfortable atmosphere, contributing to achieve positive knowledge sharing effects. Additionally, the dimension of complementary explanation can help the person who receives negative feedbacks to better understand why his or her work has received correction or criticism.

> *"We are all human, and if I force something it is normal for them to have the against emotions. What I do is to be patient and explain in details in future... If we conduct according to national regulations, the later-on problems can be less. I can't say to 100% avoid, but the problems appear less for sure. So I need to share with them why I forced them to conduct work in that way, relating to national regulations and standards. (PMI – I15 – 228-234)"*

Conflict avoiding skills can also assist project managers in sharing knowledge pertaining to people, because to prevent and address conflicts, it is important to express and share understandings towards relevant people. Similar to implementation knowledge, the knowledge domain of people that conflict avoiding skills assist in sharing is also related to disagreements or contradictions on specific issues. For example, in situations when the investing company requires a lot of design changes from the design institute and design members generate some negative feelings towards this, the project manager from the design institute can share the understandings and points-of-view from the investing company, in order to make design team members more aware of the investing company.

> *"First it's about our attitude. We need to respect the investing company, even when we put a lot of efforts to design and they still require different changes. But as project manager myself, I need to understand the investing company's concern and then share these with my team members. So they can understand the investors as well, and more willing to conduct the work." (CED – I4 – 113-115)*

The conflict avoiding skills are aimed at addressing disagreements which are about specific arguments and differences that occur during the project. This varies from the differences in interests amongst participating companies, which is discussed in the following strategic orientation skills.

5.1.3 Strategic orientation skills

5.1.3.1 Skills of highlighting common interests and knowledge domains

Being able to highlight common interests is useful in sharing knowledge of planning, especially for the construction phase where participating companies have different interests and individual concerns. As discussed in the findings (see Section 4.1.3), during the construction phase, the investing company can change some initial ideas and request re-design for a particular part of the building. Due to the fact that the overall plans were already agreed in the first and second phases and that the requested changes can affect all participating organisations, the participating organisations need to discuss and negotiate in order to formulate a feasible plan that addresses the requested changes. In this case, the design and construction take place

simultaneously in order to save time and investment; the design institute needs to accommodate relevant changes in design, and the construction company needs to address construction times accordingly. This is where conflicts between companies can occur. Being able to highlight common interests of all organisations rather than merely focusing on individual interests can help the project manager to encourage others to be more willing to listen to what is being shared and also communicate their ideas about planning.

> *"There were two major changes that the investor raised after completing the construction blueprint, when the project is under construction. The investor had some new ideas, which not because the construction blueprint wasn't good enough. It was simply because they had new ideas about something that we agreed long time ago. They changed their plan and we need to re-design a lot of things, which is quite headache. They highlighted the common interests of the project, which is that we all hope the hotel project turns out to be one of the best in our city." (PMD – I6 – 87-94)*

Highlighting common interests can also assist project managers in sharing knowledge about people, especially in the context where project managers need to explain different interests of each participating company or team. To help project members understand different participating organisations in terms of their focuses and positions within the project, the project manager needs to share his or her knowing of the project participants with others. This not only helps project members to better understand the people within the project, but also creates an environment of mutual-understanding. Being able to highlight common interests and build the project team appropriately, the project manager can enhance team cohesiveness and thus improve the team overall performance (Hwang & Ng, 2013).

Highlighting common interests is also useful in sharing strategic and operational knowledge about project business. The three participating companies can have different perspectives and focuses regarding some particular issues, due to their different positions within the project. Through highlighting the common interests behind these differences, the participating organisations can share their strategic views in terms of how to corporately conduct the work and reach agreements.

As the skills of highlighting common interests are mainly focused on addressing different interests and conflicts between different organisations, they can be considered as a part of the strategic alliance issue which is widely recognised as a critical means for alliance relationships between organisations and enhancing competitive advantage (Marshall, Nguyen, & Bryant, 2005). Strategic alliance and knowledge sharing are closely related, and the success of these relies on both the ability to acquire and share knowledge, and the motivation to learn from the alliance (Marshall et al., 2005).

> *"Investor may put appearance or beauty as the first place. Economy, beauty, usage and safety are the four principles for design. Safety is important for everybody; then among economy and beauty and usage, the investor has its options and priorities. In some case the investor can give up some space to make a style design: he spends money for beauty. This is very possible. As designer I need to let the investor have their preferences and priorities. If they give priority to beauty rather than economy or usage, we design people cannot point out it's wrong. Design itself can be an art. (PMD-I16-161:29)"*

In particular, the dimension of being able to manage requirements (see Section 4.2.3.1) can help project managers to negotiate about organisational self-interests and to reach agreements on different organisational requirements. For example, as discussed in the findings (see Section 4.1.2), the investing company considers the building utilisation and appearance as equally important; however, the design and construction companies attach more importance to the usage and safety rather than the appearance. In order to reach an agreement on specific design and construction arrangements, highlighting the common interests can assist project managers from different companies in sharing both their individual value and common goals in terms of strategic and operational suggestion.

5.1.3.2 Collaborative problem solving skills and knowledge domains

Collaborative problem solving skills are useful for project managers to share knowledge pertaining to implementation, especially in the context where an implementation related solution or agreement needs to be addressed by different participating organisations who are collaborating with each other. During the implementation when

different organisations need to cooperate to address a problem, especially when one team or one company needs to compensate or compromise in order to solve the problem, collaborative problem solving skills can assist project managers in coordinating different participants and sharing implementation knowledge with them accordingly.

> *"For some technical issues, when design institute, construction groups cannot communicate well with us, we PMs from the three companies would have a meeting first and then go to the construction field. For example, when the light is designed at the air conditioning place or at the extinguishing protection place, which functioning area should make a concession or change needs to be discussed. (PMI – I10 – 183-185)"*

A typical situation in sharing implementation knowledge is to negotiate about different ways of interpreting and collaboratively following relevant regulation items. Each participating organisation has different responsibilities and focuses on different factors. For example, some requirements from the investing company cannot be fully addressed in the design or construction work due to regulation restriction; instead of fully rejecting the requirement, project managers from different companies can collaboratively discuss alternative implementation solutions that can fulfil the requirements and also meet relevant regulation standards.

> *"We cannot make sacrifices and not follow design principles or regulations. We have our own principles and bottom lines. In the condition of obeying these lines, we can try to fulfil their (investor) requirements to solve the problems. But they cannot come up with unreasonable requirements and go against the principles. The principle here refers to the items in law or regulations - they are all written there. These are our bottom lines that cannot be crossed; otherwise there might be legal issues. Under this condition, we always try our best to fulfil investor's requirements and solve their problems. But if there are things cannot be fulfilled or solved, we have to let investor to give up their idea. (PMD – I1 – 281-286)"*

Collaborative problem solving skills can also help project managers to share and communicate strategic and operational knowledge, especially through reducing the tensions among project participants and seeking for shared solutions. In particular, the

dimension of being persuasive (see Section 4.2.3.3) can help project managers to convince others with the values and strategies being expressed and explained. Being open to discussion also helps project managers to avoid a self-centred attitude and to provide opportunities for others to express strategic and operational suggestions.

5.1.3.3 Leadership skills and knowledge domains

Leadership skills can help project managers to share their knowledge of planning. Different from other skills, applying leadership skills in sharing knowledge is more focused on guiding and directing the work and the project, and 'forcing' others to accept the decision when necessary. In situations where team members tend to disagree with a certain plan, but that plan needs to be carried out immediately, the project manager can use their 'authority' of being a leader to 'force' the team members to agree on the plan.

> *"My style in work is that I am the boss. Usually for construction, for example time length limit or team goals, I tend to be bossy. Construction industry is not like politics or teaching primary students. They construction teams are all with their techniques. If PM doesn't have personal prestige, it sometimes can be difficult for them to listen to you. It's difficult to manage the technical people. So usually I use 'high pressure' policy that I am the boss, and you need to figure out ways to complete the goals I set. (PMI – I10 – 220-223)"*

Similarly, when the disagreements are among participating companies and an agreement is needed within a timescale, the investing company can use their role, as the one who invests in the project and pays for the other two companies, to share their plans related knowledge. This can improve the work efficiency in some necessary or particular circumstances.

The appropriate decision making dimension of leadership skills is also useful in sharing planning knowledge. This is consistent with Hwang and Ng's (2013) study, in which they explained that the need for project managers to make the best possible decision on the selection of schedules and methods can help them to share planning knowledge effectively.

Leadership skills can also assist project managers in sharing knowledge about implementation, especially during the construction phase, as this phase requires a lot of coordination between different construction groups and participating organisations. In situations where the work needs to be coordinated and agreed before construction starts, leadership skills can help the project manager to arrange and direct project members so that the implementation knowledge can be better shared, understood and implemented.

> *"We have a plan in terms of how each construction team enters the construction field and how to arrange it. This is a very complex process, for example for a small part of the project, how many people are required and how many days does it need to complete; after which construction team does this one need to enter; before which construction work does this one need to be completed - it is a very accurate process. When planning it, for example there might be ten construction work need to be undertaken at the same time. These ten works all have their restrictions and limitations such as which one needs to be done ahead of or after which one - these are set knowledge. But we need to coordinate the time, such as after construction work A, work B enters the field; B entering the field doesn't affect other construction works etc. This is the biggest principle. (PMI – I8 – 129-136)"*

Leadership skills also assist project managers in sharing strategic and operational knowledge. As the role to lead the project, project managers, especially those from the investing company, have many concerns about the development, industrial environment and future operation of the project. Capabilities in envisioning the project for its success can help project managers to generate and share strategic and operational knowledge in terms of how to conceptualise and position the hotel in the market, and how to better operate in the future.

An example given by one of the investing project managers is that in leading the project, they need to think about the current market environment and political policies. A trend from the government is to reduce public sector's leisure expenditure. They analysed the future development of the project operation, and decided to utilise more space for the public such as a dedicated wedding ceremony place and to

decrease government-related places such as official meeting rooms. The application of leadership skills can assist project managers in discussing and sharing the strategic and operational knowledge for the project business, both among project managers and between the managers and team members.

> *"As the PM, first for political aspect, we are now under the lead of Communist Party, so we need to be politically approved. … For example at the beginning of planning the hotel, we sensed that the leading of new President Xi will focus a lot on anti-corruption, so we may not have many luxury rooms booked by or for the government. We put a lot of emphasis on planning and designing the halls which can be used by citizens such as marriage hall, and we didn't build many luxury rooms as usual." (PMI-I13-182)*

Leadership skills are also useful in in sharing people related knowledge, mainly in terms of the allocation of working load for project members. In leading and coordinating different tasks, project managers are required to allocate the individuals not only according to technical backgrounds, but also with consideration of personal characteristics and his/her understanding of that individual.

> *"In our team, the members have different levels in terms of work. There are generally two types of members: those who are good at difficult and challenging work and those who are skilful and quick, but not good at challenges. So in my work, I would arrange team members according to the characteristics of the project and role. If the project is not very difficult and requires a lot of repeating, I might arrange those high efficiency team members." (PMD – I6 – 50-54)*

5.1.4 Summary of the relationships

To summarise, there are important relationships between knowledge domains and skills that contribute to knowledge sharing. These relationships reveal the dynamic nature of interactions between knowledge domains and skills. To share knowledge pertaining to a certain domain, various sets of skills are required; meanwhile, one set of skills can be applied to help share multiple knowledge domains. As discussed in the above sub-sections, one set of skills can be particularly useful for sharing a domain of knowledge in some circumstances, i.e. the combination and use between a set of skills and a particular domain of knowledge are dynamic according to different situations.

This illustrates the dynamic nature of using relevant skills and sharing knowledge pertaining to different domains in the context of a construction project.

The relationships have also revealed the relational nature of the knowledge domains and the skills. In Chapter 4 Findings, it was summarised that the knowledge domains interconnect and interact with each other, and that the skills are interrelated with each other. The discussion of their relationships extends the scope towards that the interrelations between knowledge domains and skills cannot be considered in isolation; there are mutual interactions between and across them. Additionally, the application of skills and the sharing of knowledge domains can overlap and come across one another in a way that applying a certain skill can help the project manager to obtain knowledge pertaining to a particular domain. For example, the interpersonal communication skills contain dimensions of understanding the knowledge receiver, selecting the knowledge receiver and being sensitive to other's knowledge needs. By applying theses skills to communicate with project members, the project manager also obtains better understanding about the project members and thus gains more knowledge about other people in the project. Meanwhile, the enhancement of people related knowledge can help the project manager to apply interpersonal communication skills more effectively.

Additionally, the identified knowledge domains, skills, and the relationships between these two dimensions are open to different understandings and perspectives, according to the participants' organisational positions within the project. The findings provide additional insights into different levels of interpretations in terms of the priorities and importance of knowledge domains and skills that contribute to knowledge sharing. For example, project managers from the construction company attach less importance to the knowledge about planning compared to their counterparts working on investing and designing. This is mainly because the construction staffs are much less involved in the planning work. Another example is that the project managers from the investing company place leadership skills at a high level as they are focused on the value and successful delivery of the whole project; the design and construction companies however, attach less attention on the leadership

skills and are more concerned with conducting and implementing the work successfully.

The identifications of knowledge domains (as presented in Section 4.1), skills contributing to knowledge sharing (as presented in Section 4.2), together with the discussion of the relationships between them (as presented in this section), have responded to the research question introduced in Chapter 1 Introduction and have paved the way to build an integrative framework for this study, as discussed in the following section.

5.2 The integrative framework of knowledge domains and skills

5.2.1 The integrative framework

To help conceptualise the identified knowledge domains, skills contributing to share the domains, and their relationships within the context of construction projects, an integrative framework is generated and presented in Figure 5.1. The integrative framework contains and illustrates three individual dimensions: the phases of a construction project; the knowledge domains that need to be shared within the project; and the skills needed in order to share the domains. The framework also contains two areas of interaction indicating the interrelations between knowledge domains and project phases, and between knowledge domains and skills. The framework integrates the previous considerations and reveals how the skills can be applied to assist project managers in sharing knowledge within a construction project.

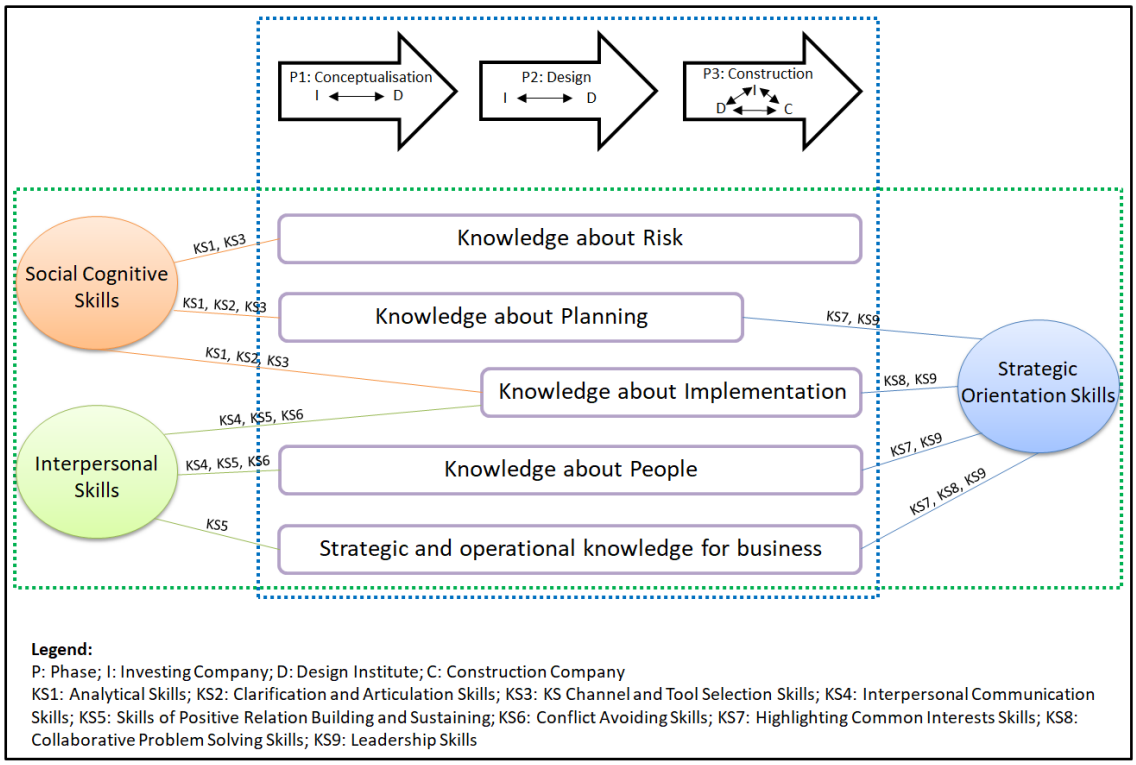


Figure 5.1: An Integrative Framework of Knowledge Domains and Skills for Construction Project Managers

The integrative framework starts with a presentation of three distinct phases of a construction project: the first conceptualisation phase where knowledge sharing takes place between the investing company and the design institute; the second design phase with interactions also between the investing company and the design institute; and the third construction phase where knowledge is shared among all three companies. These three phases are regarded as the basis from which various knowledge domains are formulated and shared, and from which the relationships between the knowledge domains and the skills dynamically interact.

A key component in the framework is the categorisation of five high-level knowledge domains, which addresses the first research objective. These knowledge domains illustrate the areas where project managers need to share knowledge with participating members; their specific explanations and dimensions are presented in Chapter 4 Findings (Section 4.1). The knowledge domains are largely aligned with the phases of the project – the domain of planning is mostly shared in the first and second

phases (also present at the third phase, although not so prevalent), implementation knowledge is shared in the second and third phases, and the domains of risk, people, and strategic and operational knowledge are shared throughout the three phases. However, the sharing of knowledge domains is of a dynamic nature, where knowledge from project managers, pertaining to the five domains, needs to be actively communicated and shared with project participants. The identification of knowledge domains is regarded as the first step in understanding and exploring the skills that contribute to project managers' knowledge sharing practice; to identify what skills are required, it is important to first identify what domains of knowledge actually need to be shared because this is where the skills need to be applied.

Skills facilitating knowledge sharing are another key component of the framework, which addresses the second research objective. Three sets of skills, together with their relationships with knowledge domains, are presented. These skills need to be developed and applied by project managers in their work, with the aim of sharing the domains more efficiently with project participants. As discussed in Section 4.3, the three sets of skills contribute to knowledge sharing from different levels and perspectives – social cognitive skills focus on interpreting different understandings among individuals and reaching shared meanings; interpersonal skills are aimed at creating a positive working environment for sharing knowledge; and strategic orientation skills assist project managers in sharing different organisational interests among participating companies, and collaboratively reaching agreements and solving problems.

The integrative framework also demonstrates the important relationships between knowledge domains and skills; this is presented in the framework via the links between them and addresses the third research objective. Each link illustrates which dimensions of a specific set of skills are particularly useful in sharing relevant domains of knowledge. The relationships indicate the interconnections between the skills and knowledge domains in such a way that the application of the former needs to be considered with the sharing of the latter, i.e. certain skills are more in conjunction with certain knowledge domains and the need to share knowledge pertaining to a particular domain triggers the application of particular skills. They should be understood as

interrelated, overlapping and intersecting through specific situations and activities engaged with during the project.

5.2.2 Novelty and implications of the integrative framework

The results generated by this study extend the literature on construction project knowledge and skills contributing to knowledge sharing. This study firstly identifies specific knowledge domains and secondly, the skills to share the knowledge domains. Based on these, the present study integrates the knowledge domains and skills that contribute to the sharing, not only in terms of which skills set assists in sharing which knowledge domain, but also what particular dimensions of that set are useful in the sharing. It is important to integrate rather than take a separate approach because the knowledge domains and skills facilitating the sharing are inter-related and can affect one another in knowledge sharing practice.

Three main arguments can be put forward in support of this framework. To begin with, the three-phase construction project is a collective and interactive process that involves dynamic sharing of knowledge and dynamic application of skills. Knowledge differences between actors are not just in degree, but also in type (Carlile, 2004). The variety of knowledge domains and the fluid sharing of knowledge pertaining to different domains, throughout different phases, illustrate one key aspect of the dynamic engagement within the project. Domains containing different knowledge are distinguished by their content and focus; as the project evolves through different phases, the focus of a knowledge domain can change according to specific situations. Besides, construction projects have the characteristic of uncertainty i.e. unexpected events can occur (Pirzadeh & Lingard, 2017); this leads to the development of a dynamic context in which different knowledge needs to be shared dynamically and in a timely manner to address unexpected events. Furthermore, the integrative framework reveals dynamic integration and interaction between the sharing of knowledge and the application of skills. With the increasing demands and complexity of the construction projects, the conceptualisation, design and construction phases have become progressively more sophisticated requiring dynamic and effective sharing of knowledge between participants (Austin, Thorpe, Root, Thomson, & Hammond, 2007). With different participants engaged in the three-phase development of the project, the

combination of which skills to apply for sharing knowledge pertaining to certain domains, constantly changes throughout the project. Also, as each phase has varied objectives, the combination between the domains and skills can emerge dynamically in response to varying needs.

The term 'dynamic' indicates change, energy and productivity; knowledge is considered to have a dynamic nature because it constantly changes and evolves with experience and learning (McInerney, 2002). This dynamic nature can be a force for solving problems and sharing knowledge. Therefore, the dynamic interactions between knowledge domains and project phases, and between knowledge domains and skills, contribute to facilitate knowledge sharing actively within the project. This can help to address problems that occur, and thus positively affect the knowledge sharing and project performance. Besides, the dynamic nature can also be a force for generating new knowledge (McInerney, 2002). Knowledge sharing in projects can extend from merely sharing knowledge about a particular issue to enable discussions among stakeholders and then reach a mutual understanding – this in the end exceeds the original knowledge being shared. It can be seen as a process of knowing in practice that the sharing is an ongoing social activity or accomplishment, constituted and reconstituted as actors engage with the work (Orlikowski, 2002). The dynamic nature enhances the knowing and sharing processes.

The second argument is based on the suggestion that the application of skills and the sharing of knowledge pertaining to different domains do not operate independently of each other, but overlap and interact over the duration of the project. In organisational studies, dependence is considered as a condition where two entities, in order to meet their goals, need to take each other into account (Carlile, 2004). A collective and relational nature exists both in and between knowledge domains and skills that contribute to knowledge sharing. The knowledge domains cannot be separated from one another (as discussed mainly in Section 4.1); the application of skills is interconnected (as presented mainly in Section 4.2); and more importantly, the interrelations between domains and skills cannot be isolated (as shown in Section 5.1). Project managers' practice in the construction industry requires various types of knowledge – beyond that of purely technical or engineering knowledge – coupled with

skills (Edum-Fotwe & McCaffer, 2000). The application of certain skills, as shown in the integrative framework, can facilitate the sharing of certain knowledge domains. Besides, the process of sharing knowledge can be considered as a process where individuals contribute with their own ideas and gain collective accumulation of knowledge (Cabrera & Cabrera, 2005). Different sets of skills can assist project managers to share knowledge and address different challenges that occur in the project; in return, they obtain new knowledge through this process (Hwang & Ng, 2013). Therefore, project managers can obtain new knowledge and enhance their original knowledge by applying the skills whilst communicating and sharing with others.

The overlap and interaction of knowledge domains and skills indicates the existence of interplay between these two entities. The knowledge being shared from and between actors in conducting their work is not merely a matter of following rules or processes, but involves engaging with what is valued professionally (Edwards & Daniels, 2012). Project managers, as professionals, need to apply different skills in their knowledge sharing practices. This is not only to help others understand the knowledge being share, but also for the purpose that project managers themselves can be stimulated with what the project members think, and receive new questions and feedback from them. Therefore, sharing knowledge pertaining to different domains is a process to develop and apply individual skills for knowledge sharing; through the application of such skills, the knowledge pertaining to different domains can be enhanced.

The final argument is that the sharing of knowledge domains and the application of skills are constrained by individual perspectives and introduced by organisations who hold different positions within the project. They are open to different understandings, interpretations and perspectives according to the organisational position of participants within the project. For a situation or issue, its nature can be analysed and interpreted by using different items and focuses (Chen, Ibekwe, & Hou, 2010). For a construction project, participating organisations have their own priorities in terms of which knowledge domains need to be shared and which skills need to be applied. The different perspectives can also be seen as a collaborative learning process – project managers act and perform differently based on their own views and meanwhile can

learn and understand about other perspectives within the project (Cicmil, Williams, Thomas, & Hodgson, 2006). After taking into consideration the different understandings and positions, project managers can make adjustments to the different decisions they have made in terms of which knowledge to share and which skills to adopt and apply during the sharing.

By providing an identification and categorisation of knowledge domains (risk, planning, implementation, people, strategic and business knowledge), skills facilitating the sharing of knowledge domains (social cognitive, interpersonal, strategic orientation), and the relationships between them, this study provides a useful basis for future research in both project and knowledge management. The variety in domains and skills also contributes to understand that knowledge sharing as a practice is not merely about the moment of sharing with others. Being able to formulate the appropriate knowledge and organise the knowledge in a clear structure before starting to share can also significantly influence the outcome. The capability of strategic orientation can also affect knowledge sharing efficiency, especially when different interests occur among participating organisations.

Based on these three arguments that the integrative framework reveals a dynamic, inter-related and multiple-perspective nature of knowledge domains and skills that contribute to knowledge sharing, the framework contributes to the literature by answering the 'what' and 'how' question. The integrative framework provides a categorisation of 'what' domains of knowledge that needs to be shared and a categorisation of skills in terms of 'how' to share the knowledge pertaining to different domains effectively. Furthermore, it provides the specific relationships between knowledge domains and skills. This contributes to address an identified literature gap that studies about knowledge domains or skills usually take the approach to consider these two subjects separately without exploring specific relationships between them (Hwang & Ng, 2013; Navimipour & Charband, 2016).

In addition, by exploring knowledge domains and skills for the particular role of project managers within a construction project, this research integrates and brings together two disciplinary areas of knowledge management and project management. Project

management and knowledge management are interdisciplinary research; project management is partially regarded as a knowledge management issue, and knowledge management plays a crucial role in managing projects (Garwood & Poole, 2018). The dynamic nature and different perspectives for knowledge sharing for project managers, how they change across different phases of a project, together with different positions of actors and organisations within this process, is illustrated by the integrative framework. This contributes to bring together different research traditions including knowledge sharing, knowledge possession (e.g. Metaxiotis, Ergazakis & Psarras, 2005), project management (e.g. Garwood & Poole, 2018) and institutional logics with different perspectives (e.g. Currie & Guah, 2007; Bakker, DeFillippi, Schwab & Sydow, 2016).

5.3 Relating the integrative framework to existing theory

5.3.1 Relating knowledge domains and skills contributing to knowledge sharing to existing studies

This sub-section individually revisits the identified knowledge domains (presented in Section 4.1) and the skills contributing to knowledge sharing (presented in Section 4.2); it reflects on their properties, dimensions and the current literature. This study considers a construction project as an arena in which the knowledge domains of risk, planning, implementation, people, and business strategies and operations need to be shared; social-cognitive skills, interpersonal skills and strategic orientation skills need to be applied in order to share these domains and to achieve the expected results.

Prior to the main discussion, the context of the construction project needs to be discussed, as the context identified in this study differs from the widely recognised context presented in the literature as presented in Section 2.7. A construction project is widely recognised as being composed of four phases. As shown in Figure 2.9, the investing company, design institute and the construction company are the drivers of the first three phases respectively; the design institute therefore is at the centre of the project, connecting the investor and the construction company.

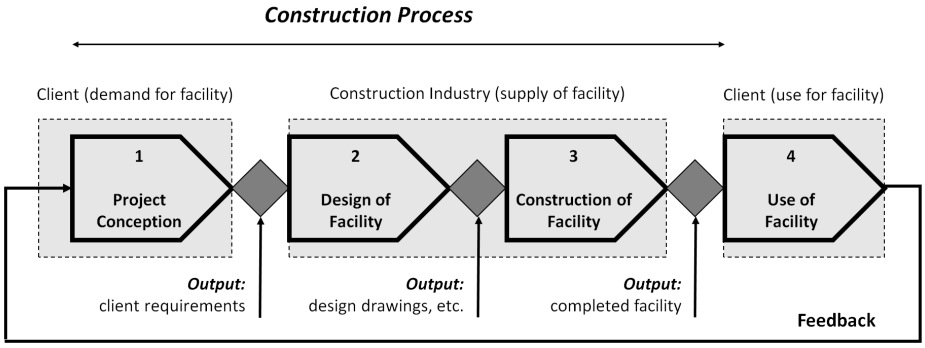
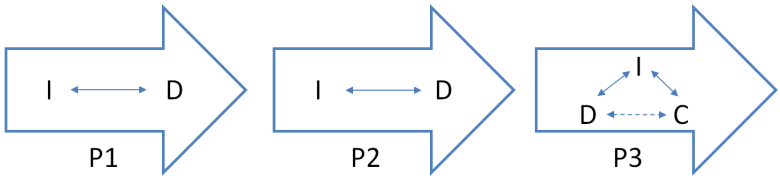


Figure 2.8, Simplified Model of Construction Process (Kamara et al., 2002)

However, from the knowledge sharing perspective, the findings in this study indicate that the relationships between these three participating companies are more complex. As shown in Figure 4.2 presented in Section 4.0, the three main stages remain the same but with different participants driving the process. Knowledge sharing in a construction project involves three main stages: during the first stage, knowledge is shared between the investing company and the design institute; during the second stage, knowledge is shared between the investing company and the construction company; during the third stage, knowledge is shared among the investing company, the design institute and the construction company. What is important to note, is that during the third stage, the investing company remains at the core of knowledge sharing, because it is they who are in the position of guiding and approving work. According to the research data, most of the knowledge sharing between the design institute and the construction company happens with at least one member form the investing company being present. This finding is consistent with the results from Hwang and Ng (2013) and Glavinich and Taylor (2008). Since construction projects, especially those that are creating a high-end product, require a more holistic and integrated approach, the design phase is therefore more complex and can overlap with the construction phase (Hwang & Ng, 2013).



Legend: P: Phase; I: Investor; D: Design Institute; C: Construction Company

Figure 4.2, Knowledge sharing through three stages of the hotel project

5.3.1.1 Relating knowledge domains to existing studies

The knowledge domains in this study are largely aligned with the three phases of the project. This is consistent with the wide recognition that knowledge cannot be easily stored or understood, is highly dependent on the context, and needs to be shared in a timely manner in order for its value to be realised (Mårtensson, 2000). Therefore, as the project evolves from one phase to another, the knowledge that project managers need to share and the focuses of each knowledge domain also shift, together with the project phases. The remaining part of this sub-section discusses each knowledge domain with the relevant studies.

The findings in this study indicate that knowledge about risk (see Section 4.1.1) is important for project managers to share within the construction project. In this study, knowledge about risk is concerned with project managers' predictions and identifications together with their reasoning for them, in terms of the factors that can cause possible threats in the project environment. This definition formulated by the findings has some overlap with the concept of risk in project management research. In project management, risk in a construction project refers to the likelihood of a definite event or factor, or combination of the two, that causes harm to the project (Wang et al., 2004). Both concepts indicate that the sharing of risk related knowledge involves the risk itself and also the analysis or reasoning of different factors.

The knowledge domain of risk is composed of three dimensions; potential risks in design, and sequential disturbance are focused on risks during the project work, whereas the dimension of long-term sustainability of the building is concerned with risks after the project is completed. The typical systematic risk management in the

construction industry consists of three main stages: i) risk identification; ii) risk analysis and evaluation; and iii) risk response (El-Sayegh, 2008). The knowledge domain pertaining to risk includes the process of project managers identifying the risk, and analysing and evaluating the risk; the sharing process can be considered as the process of seeking responses from knowledge receivers. In addition, the knowledge about risk identified in this study is mainly concerned with the project itself. In project management research, there are studies focusing on external risks at political or national level (Tang, Qiang, Duffield, Young, & Lu, 2007; Zuo & Zhang, 2018). However, the focus of this study is to identify the critical knowledge discussed by project managers in their work; the findings indicate that the internal risks within the project itself are shared more frequently. As pointed by El-Sayegh (2008), every project contains some degree of risk, but to try to identify every single risk that exists is time-consuming and counter productive.

Another important domain of knowledge that needs to be shared by project managers is planning knowledge (see Section 4.1.2). The results of this study show that planning includes not only specific methods or techniques, but more importantly, knowledge about the broader context of the project. This includes the market, local culture, the project's overall features and generic requirements; these considerations need to be properly communicated among project managers when they make plans and share planning knowledge. This finding can be explained by Bower and Walker (2007)'s study; they argue that the key focus for project planning knowledge should be about developing a deep understanding of the project characteristics and context rather than the techniques to be used (Bower & Walker, 2007). Knowing and sharing the context and project characteristics can assist project managers in planning and positioning the project for a suitable market place to generate sustainable competitive advantages.

This study identified six dimensions for planning knowledge as presented in Section 4.1.2, with the first three focused on the contextual considerations of the project and the latter three concerned about the resources and requirements of the project. The findings illustrate that the sharing of these six dimensions is largely aligned with the project development. The knowledge about market segmentation and local culture needs to be shared first, and the sharing of these two elements can influence the

sharing and planning of the hotel style; then, knowledge about resources and requirements - including early concept and requirements for the project, balance between appearance and utilisation, as well as time frame - need to be shared. Therefore, the discussion of requirements and resources planning depends on the communication and decision of the contextual considerations of the project plan. This is consistent with Phaal, Farrukh, and Probert (2004)'s theory that planning on implementation or technology cannot be developed independently from planning of the contextual business strategies; in fact, the implementation or technology is an integral part of business plans and needs to be shared with the purpose of completing the overall business plan. This part of the findings is also relevant to Gidado (1996)'s study of planning knowledge. In the construction industry, planning can be viewed from two perspectives: the managerial perspective that involves the planning of bringing together various considerations to form a generic idea; and the operative perspective which contains technical activities to execute individual pieces of work (Gidado, 1996). Besides, the findings reveal that the first three dimensions of planning knowledge should be precise as they guide and position the project in the market context; while the latter dimensions of planning knowledge are on a flexible basis. For example, project managers highlighted that time frame planning should be flexible and consider some unexpected emergent situations. This finding is supported by Bower and Walker (2007)'s study that planning should be flexible as project managers should understand the complexity of the project and schedule in extra time in order to overcome unexpected problems.

Another knowledge domain identified in this study is implementation knowledge (see Section 4.1.3). Implementation knowledge, or 'procedural knowledge', is widely recognised and referred to in knowledge management and project management research. It is defined as knowledge of project and organisational solutions (Lampel et al., 2008), understanding of 'how to do' and 'how to act' (Reich et al., 2012), producing and using of the project product (Kasvi et al., 2003), and knowing project procedures, and the elements within each procedure (Gasik, 2011). Similar to the existing theories, this study indicates that implementation knowledge is concerned about how to

address a problem or a situation during the project, which is usually associated with project managers' work experience and the lessons learned.

The findings regarding implementation knowledge highlight the importance of the three participating companies closely working together. The project is composed of different companies and different functional areas, both in design and in construction. However, to address complex situations such as accommodating a critical change in both blueprint design and construction work, perspectives and knowledge from different participants is required. Particularly, in the construction phase, where the blueprint design and construction work can happen simultaneously as described in Section 4.1.3, the close working and knowledge sharing across organisations is very important. This can be related to the discussion of knowledge sharing at an inter-organisational level. Inter-organisational knowledge sharing as a manner of exchanging and communicating knowledge from different organisations can help to gain mutual benefits via accessing to a wider range of ideas, as different organisations have their advantages and own areas of expertise (Cummings, 2004). It is important to enhance the knowledge flow across organisational boundaries and facilitate the integration of knowledge (Lampel et al., 2008). An important part of this process is to enable the different groups to develop common understandings of the aims and their own common interests of the project (Lampel et al., 2008), which is also relevant to the strategic orientation skills presented in the integrative framework.

Sharing knowledge about people (see Section 4.1.4) is also important for project managers. The results of this study suggest that people related knowledge is focused on two dimensions: knowledge about people who work inside the project; and knowledge about people outside the project such as external consultants or partners. For the internal side, it is important to share knowledge in terms of setting and adopting human resources requirements for the project, such as selecting internal organisational members to participate in the project. The knowledge being shared during this process involves both technical capabilities and more importantly, the style and characteristics of the individual or the group. This finding is relevant to Wright, Dunford and Snell's (2001) people management theory. Wright et al. (2001) identified that it is important for firms to have internal discussions about designing appropriate

work standards and positions, and to understand how this impacts on their access to valuable human capital; this expands the knowledge beyond explicit human resource requirement lists towards considerations of culture, attitudes and cognitions. E. Cabrera and Cabrera (2005) also suggested that in selecting appropriate employees, the importance of compatibility between the organisation/project, in terms of its beliefs and values, and employee characteristics – including individual personality and needs – should be emphasised. Another important dimension identified in this study, regarding people knowledge, is the understanding of minimising and addressing conflicts that occur within the project. Relating the 'theory of reasoned action' from the knowledge sharing perspective, the engagement in a specific behaviour is determined by the attitude of the individual towards that behaviour; applied to knowledge sharing, positive attitudes towards knowledge sharing can improve the individual engagement in knowledge sharing practice (Cabrera & Cabrera, 2005). Conflicts between project participants can negatively affect their attitudes towards sharing and receiving knowledge from others; therefore, communicating about preventing and solving conflicts among relevant project managers and members is necessary.

The last knowledge domain identified in the present study is knowledge of business strategies and operations (see Section4.1.5). The findings suggest it is concerned with the value and interest of the project and the contextual knowledge about the construction industry, with the overall aim of placing the project in a competitive position. This confirms Reich et al.'s (2012, p. 666) description about business value knowledge within a project, *"the dynamic shared understanding of the business objectives and that the project is expected to deliver*". The results from this study further specify the business value into two levels: the value of the participating organisations as independent stakeholders, and the value of the project as a whole. As presented in Section 4.1.5, both of these dimensions need to be shared; it tends to be more difficult to share the value of individual participating organisations as organisational self-interests sometimes can conflict with one another. Consistent with Reich et al.'s (2012) argument that individuals' understanding towards the project value is dynamic as it can develop and change throughout the project lifecycle, project

managers in this study communicated their ideas about the expected outcomes and their visions were modified as the project evolved. These findings draw attention to both the importance of sharing knowledge about business strategies and operations, and the dynamic nature of the knowledge.

Although previous studies have identified the importance of context related knowledge for project strategies and operations, findings from this research have specified and emphasised the importance of context related knowledge. When sharing business strategies and operations, the tacit business rules regarding the construction industry, the economic market and the local government constitute an important dimension that needs to be emphasised during knowledge sharing. This can contribute to the placing of the project at an appropriate position within the local market and wider industry, as well as to improve working efficiency with relevant governmental departments.

5.3.1.2 Relating skills contributing to knowledge sharing to existing studies

Social-cognitive skills

In this study, social-cognitive skills (see Section 4.2.1) focus on the project manager analysing various situations that arise within the project, as well as the individual knowledge, with the purpose of sharing appropriate knowledge and addressing the current issues. This is consistent with Kotlarsky, Hooff and Houtman's (2015) argument that the need for cognitive process and social-cognitive skills during team work is based on two facts: 1) specialisation leads to differences in individual knowledge; 2) some common knowledge is required in order to address the situations and work effectively. Oluikpe's (2015) study also confirms that project team members tend to reply on a shared context and common interpretation in order to make sense of the project knowledge that they receive or share. The findings of this study reveal that social-cognitive dimensions of the project manager, such as analysing situations and selecting knowledge-sharing methods, can affect the way he/she perceives the external setting (i.e. the project setting) and shares relevant knowledge. The cognitive understanding and agreement among a social group is gained through a shared language or shared narratives among its members (Cabrera & Cabrera, 2005). The definition of social

cognitive skill is widely discussed in physiological research; the development of individuals' cognitive, social and behavioural skills can improve their capabilities in achieving goals (Wood & Bandura, 1989). In organisational and knowledge management studies, social cognitive skill is rarely discussed.

Being analytical within the context of a project is an important dimension of social cognitive skills and resembles the notion of conceptual and organisational skill as described by (El-Sabaa, 2001). El-Sabaa (2001) studied how project managers and functional managers differ with respect to their skills and experiences, and argues that conceptual and organisational skill for project managers refers to their ability to envision the project as a whole, including being able to plan, organise and solve problems. He suggests that this skill places an emphasis on being able to see the project in a way where the various functions and phases within it are not isolated but depend on one another. This is consistent with the analytical dimension in terms of being able to think in a cross-functional and integrational way and share this knowledge with project members. To address a situation within a project, project managers should be able to not only understand the situation and the processing stage, but also envision the project as a whole and acknowledge that stages are interconnected and affect each other (Lord & Hall, 2005). El-Sabaa (2001)'s research and the findings from this study are also in agreement that project managers should be capable in terms of 'how to do' and 'how to act' in specific situations, in order to share individual knowledge and reach mutual understanding within the team to solve problems.

One of the main aims of applying social cognitive skills is to identify differences in knowledge among relevant project participants, and reach shared meanings and mutual understandings within the project, as discussed in Sections 4.2.1 and 4.2.5. This aim can be achieved through the project manager interpreting both others' thoughts and individual knowledge. This dimension of social cognitive skills is relevant to Edwards (2011)'s relational agency theory. Edwards (2011) described the relational agency as the capacity to align individual thoughts and actions with those of others, with the aim of interpreting problems in practice and responding to others' interpretations. Therefore, the social cognitive skills and the relational agency concept

are consistent in terms of perceiving and aligning the thoughts of others. Additionally, in the practice of knowledge sharing, knowledge receivers first interpret the knowledge and then act on the basis of their interpretations (Edwards, 2011). The analytical dimension of social cognitive skills contributes to interpretation by enabling individuals to analyse and understand various factors; the clarification and articulation dimension, and the selecting tools and methods dimension of social cognitive skills contributes to actions (these two dimensions can be considered as such i.e. actions based on the understandings).

Interpersonal skills

The set of interpersonal skills (see Section 4.2.2) is concerned with working with people, being able to communicate appropriately, building and sustaining positive relations, and avoiding conflicts. This is similar to the 'human skills' defined by El-Sabaa (2001); he described how project managers with highly developed human skills are skilful in communicating with, and motivating others. Therefore, the information and knowledge can be shared effectively and the project goals accomplished. Human skill is demonstrated by the way a project manager observes, recognises and responses to the attitude of his colleagues (El-Sabaa, 2001).

This study has identified that, appropriate interpersonal communication is an important component of interpersonal skills. When considering the context of China and cultural influence, interpersonal communication skills are particularly important in sharing knowledge. Zhang and Ng (2012) suggested that due to collective culture, Chinse people are more socially orientated compared to western people; Chinese organisational members have a higher tendency to share knowledge through face-to-face communications and phone calls rather than emails or computerised systems.

The findings in this study suggest interpersonal skills, particularly the dimension of building and sustaining positive relations, are important for project managers to create a positive knowledge-sharing environment. Building and sustaining positive relations focuses on both internal relations within the project and external relations with counterparts working in participating organisations and the wider construction industry. For internal relations, a study by Fligstein (2000) illustrates that establishing

stabilised relations with people within the same company as the project manager and those from other organisations, can help to obtain cooperation in project work and to share knowledge more effectively. Furthermore, in the context of China where the Confucianism and harmony are highly valued, people tend to put more effort in to building personal relationships with colleagues (Su et al., 2003). For the external relations, the relational agency theory from Edwards (2011), as presented above, confirms that joint actions can expand the object that one is working on and access new knowledge resources, via recognising what another person may be a resource to align oneself to the other. This confirm that expanding social relations externally with counterparts in the industry can help the project manager to access more knowledge resources and therefore share knowledge more effectively with project members.

This study also indicates that avoiding conflicts is an important dimension of interpersonal skills in sharing knowledge. Conflicts or contradiction is inevitable in conducting project work; however, it is more important to avoid and properly address conflicts for the Chines context than in the western counties. The findings from this study reveal that to avoid conflict, identifying the appropriate time and location to share corrective feedback and to offer further explanation about any negative situations is useful. This can be explained by Huang et al.'s (2011) research. Chinese people are more concerned with self-image and others' opinions of them, which has developed their strong intention in both avoiding losing 'face' and gaining 'face' in front of other people (Huang et al., 2011). Therefore, when the project manager shares corrective or negative feedback with a person, sharing at an appropriate time and location can help to avoid both making the receiver feel embarrassed or to lose face and to avoid potential conflicts within the project team.

Strategic orientation skills

The third set of skills in the present study, strategic orientation skills (see Section 4.2.3), are concerned with aligning knowledge sharing practices with business and project strategies, in order to achieve long-term success in terms of both knowledge sharing and the project. This concept is similar to Connell and Voola's (2007) strategic alliance, which demonstrates that knowledge sharing should be integrated and aligned with the

organisation's strategic thinking in order to gain a mutual advantage. The most successful knowledge sharing practices are those that are closely tied to the business and the strategic objectives (Riege, 2005). This assists organisations and projects to develop a knowledge-based business view and place more emphasis on sharing knowledge to serve the business purpose.

The research area of strategic knowledge management and knowledge sharing has been discussed among researchers, involving the linking of knowledge management strategy to business strategy, and acquiring and sharing knowledge to make strategic decisions (López-Nicolás & Meroño-Cerdán, 2011). However, most of the studies have been conducted in the context of organisations. For projects with different participating organisations and temporal nature, the focus and application of strategic orientation skills can be different.

In particular, the dimension of highlighting common interests, in strategic orientation skills, indicates the occurrence and difficulty when conflicts of interest appear among participating organisations within the project. It is important for project managers to recognise the mutual interests and potential agreements, in order to align the knowledge sharing with overall development of the project. This is similar to what Carilie (2004, p.560) stated: "*Common interests are developed to transform knowledge and interests and provide an adequate means of sharing and assessing knowledge*". In order to collaboratively solve a problem when various participating companies with different interests are involved, it is important for individuals to face the need of altering what they are willing to do in order to develop new ways of dealing with the confronted problem (Carlile, 2002). Highlighting common interests also involves identifying the position of a participating organisation in terms of its parent organisation's interests. This is relevant to El-Sabaa's (2001) finding that project managers should have the skill of visualising the relationships inside the project and the relationship of an individual project to the parent organisations; they should act in a way that advances the over-all benefits and welfare of the project and the involved parent organisations. Therefore, through applying strategic orientation skills, the benefits and interests of both the project and the participating parent organisations are considered and enhanced.

The findings suggest that the skills supporting project managers in knowledge sharing and the dimensions these skills are not merely concerned with the technical or engineering part of the construction project. Instead, they are more focused on enabling knowledge sharing from non-technical perspectives. However, this does not imply that the engineering or technical skills are not important for project managers. The findings of this study indicate that engineering knowledge and skills are the basic knowledge and capabilities that project managers should acquire, which are exemplified in Sections 4.1.1 and 4.2.1. But to achieve successful knowledge sharing in practice, the required knowledge and skills transcend those scopes and are more complex and diverse. This is confirmed in the study by Hwang and Ng (2013). They point out that project managers must first possess knowledge of technical aspects of the construction industry to an extent that they understand the project and service being delivered; however, much of the knowledge and skills to manage the project demands a context much wider than the subject boundaries defined by the engineering requirements. Knowledge sharing practice by construction project managers should therefore be coupled with skills that extend beyond the technical aspects (Edum-Fotwe & McCaffer, 2000).

5.3.2 Relating the integrative framework to knowledge management models

5.3.2.1 Comparison with the tentative framework

In Chapter 2, a tentative framework of knowledge domains and skills was developed as shown in Figure 2.10, on the basis of a critical literature review process and with focuses on the fields of knowledge domains, skills, and on linking these to the context of project management and project managers. The tentative framework presents four domains of knowledge that need to be shared and six skills that are useful for knowledge sharing activities in conducting project work. The aim of the framework was to synthesise and summarise the current literature, based on a synthesis of different authors and papers in the fields, in relation to the research topic.

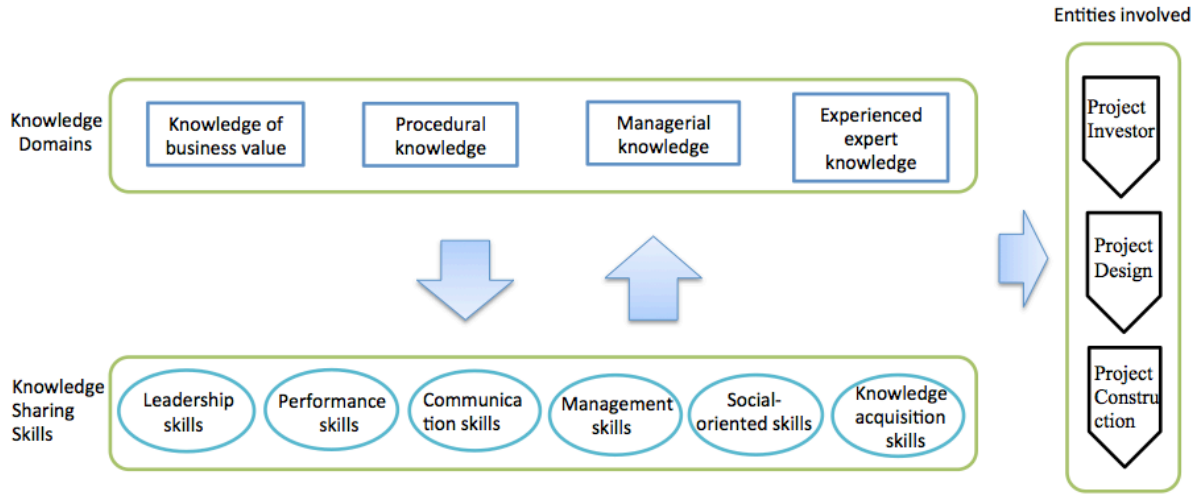


Figure 2.2: Tentative framework of knowledge domains and skills facilitating knowledge sharing

In terms of knowledge domains, in the tentative framework, the knowledge that needs to be shared pertains to four main domains and these four domains are explained in detail in Table 2.3 (on page 38-39). Knowledge of business value provides understanding of the goal and value that the project is expected to deliver, and the other three knowledge areas offer support in order to achieve the goals. These four knowledge areas are of a tacit nature; they are associated to the "know how" knowledge, personalised in individual minds and fitting its particular environment and culture (Smith, 2001). For skills that contribute to knowledge sharing activities, six sets of skills in the tentative framework are discussed in Table 2.4 (on page 70-72). These sets of skills are concerned with both the management responsibilities and knowledge sharing activities for the role of project managers.

To compare findings from this research to the tentative framework, firstly, the categorisation in the tentative framework remains at a generic level. In the tentative framework, 'high-level' categories of knowledge domains such as procedural knowledge and experienced expertise knowledge, and generic skills such as leadership skills and communication skills are presented, but without further explaining what each classification involves or what dimensions each classification has. This research extends the existing literature by using a single case study, i.e. examining a hotel construction project, and reveals a new categorisation of knowledge domains and skills in order to improve project managers' knowledge sharing efficiency. The new

categorisation provides a comprehensive explanation for each category by illustrating specific dimensions or components for each domain and set of skills.

For example, knowledge of implementation merged as a main category in the research findings; it is relevant to the domain of procedural knowledge in the tentative framework. The categorisation from this research provides more specific insights into what implementation knowledge means and involves, such as emergent investing requirement and collective interpretation of regulations. It provides a detailed description of the knowledge domain within a typical hotel construction project. In addition, interpersonal communication skills in the findings of this research are similar to the communication skills in the tentative framework; leadership skills in this research are also aligned with the leadership skills in the tentative framework. This study provides a detailed description and explanation in terms of what these skills involve, such as interaction encouraging and effective decision making, from the perspectives of project managers within a hotel construction project. Furthermore, in the tentative framework, the category of expert experienced knowledge is widely recognised as a separate knowledge domain. This study reveals that the five knowledge domains in this research are all associated with expert experienced knowledge; therefore, it is not a separate category but embedded within other knowledge domains. In this perspective, this study offers a higher level of detailed categorisation by 'unpacking' what existing studies view as expert experienced knowledge in a particular context, i.e. the context of a hotel construction.

Secondly, findings in this research illustrate specific relationships between different categories of knowledge domains and between different skills, which is not presented in the tentative framework. For skills that contribute to knowledge sharing, in the tentative framework, the six sets of skills remain independent without connections or relationships. This research reveals the complementary relationships between the three sets of skills and their different levels in applications. Social cognitive skills are focused on the project manager him/herself in terms of individual thinking process; interpersonal skills are focused on the external environment within and beyond the project; strategic orientation skills concern about organisational positions and issues involved within the single project. These three sets of skills complement each other

and are also interconnected through the dimensions of the skills. In terms of knowledge domains, the four categories in the tentative framework are also isolated from one another. In this research, the five knowledge domains are developed and related to the three phases of a construction project; each domain is linked to its relevant construction phases. They are largely aligned with the project lifecycle. This contributes to understanding the dynamic nature of sharing with the evolvement of construction project, and the interrelated nature of the knowledge domains within the project.

Thirdly, the integrative framework in this research also reveals detailed relationships between knowledge domains and skills, which are neglected in the existing literature and in the tentative framework. Social cognitive skills are useful in sharing the knowledge domains of risk, planning and implementation. Interpersonal skills can be applied to share the knowledge of implementation and knowledge of people, with one dimension also being useful in sharing strategic and operational knowledge. Strategic orientation skills can assist project managers in sharing business strategies and operations knowledge, as well as, knowledge of planning, implementation and people. The relationships add to the tentative framework by integrating the two individual elements of knowledge domains and skills within the context of a typical construction projects.

5.3.2.2 Comparison with the Integrative Framework for Managing Knowledge across Boundaries (Carlile, 2004)

Carlile's (2004) framework of Managing Knowledge across Boundaries provides insight into knowledge boundaries and managing domain-specific knowledge. The framework includes three boundaries and processes as demonstrated in Figure 5.2. Carlile's (2004) framework and the integrative framework in this study overlap on some key elements.

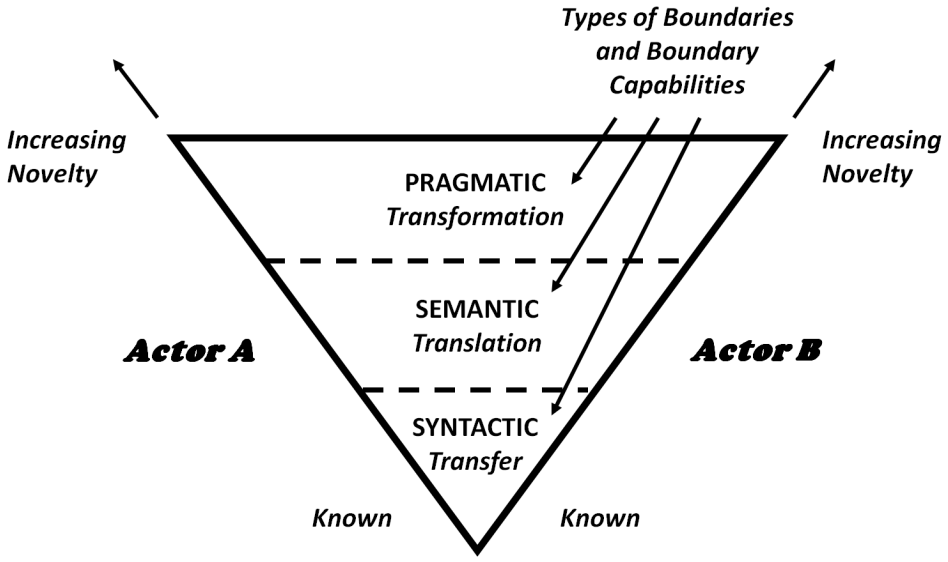


Figure 5.3: An integrated framework for managing knowledge across boundaries (Carlile, 2004)

The findings from the present study suggest that, whilst knowledge domains are different, they are also inter-related and dependent. To address a situation in the construction project, sometimes the knowledge pertaining to different domains needs to be shared together. In the context of Carlile's (2004) study, knowledge at different boundaries is considered with the properties of both differences and dependence. Knowledge among actors is different in terms of the amount of accumulated knowledge and different types of domain-specific knowledge (Carlile, 2004). An organisation can be viewed as a bundle of different types of boundaries; most innovation and knowledge sharing occurs at the boundaries between specialised domains (Carlile, 2004). This helps to explain the necessity of differentiating knowledge domains in the present study. Besides, actors working towards the same goals are dependent on each other, and this dependent relationship has sequential links with the activities of managing and sharing knowledge (Carlile, 2004). Carlile (2004) further pointed out that when the degree of dependence increases, the complexity and efforts to share knowledge also increase; to share knowledge, an adequate understanding of the subject that the knowledge is about is required. Therefore, the dependent and relational characteristics of knowledge make it important to communicate and share knowledge in a timely fashion. This aligns with the argument made in the present study

that applying appropriate skills to share relevant knowledge is important for effective knowledge sharing.

Another important element of the integrative framework is the three sets of skills. The present study identified three sets of skills that are required by project managers and contribute to their knowledge sharing practices. Carlile (2004) identified three approaches to manage different types of knowledge boundaries.

Firstly, for a semantic boundary where different domains generate interpretive differences and individuals possess ambiguous meanings, the interpretive differences in what one word, sentence or outcome means, can negatively affect the sharing of knowledge between actors (Carlile, 2004). To address this, translating knowledge with the aim of reaching a shared meaning should be adopted as shown in Figure 5.2. The 'translation' here is relevant to the social cognitive skills in the integrative framework, as they are both concerned with, and focused on, interpreting meanings of oneself to others, with the aim of reaching mutual understandings. In the present study, social cognitive skills (see Section 4.2.1) are concerned about project managers analysing the situation and clarifying the knowledge in a way that others can understand the knowledge and that a shared meaning can be reached. Carlile (2004) described translation as moving knowledge across boundaries to develop common meanings, and the person who conducts this work acts as the role of knowledge broker or translator.

Secondly, the other similarity is between strategic orientation skills (see Section 4.2.3) in the present study and transforming knowledge in Carlile's (2004) framework. The strategy of transforming knowledge is concerned with situations where different interests among actors occur and such differences need to be resolved. When actors have different interests, especially when those interests conflict, the knowledge developed within one domain can generate negative consequences in another (Carlile, 2004). Under these circumstances, the domain-specific knowledge, as well as the common knowledge used, needs to be re-worded and transformed in a way that can be effectively shared, assessed and accepted by different individuals (Carlile, 2004). The strategic orientation skills in the present study also recognise the existence and influence of different interests among project participants and stakeholders, especially

among the three participating companies. Particularly, the dimensions of strategic orientation skills, sharing common goals, and aligning participants towards shared purposes, focus on addressing the conflicts or different interests through 'transforming' the knowledge towards the common interests between actors. The sharing process of common interests and goals contributes to the reaching of agreements and the resolving of the *"hard communication and negative consequences by the individuals"* (Carlile, 2002, p.445). Furthermore, 'transforming' refers to the alteration of current knowledge to create new knowledge that is validated and accepted both within each function and collectively across teams (Carlile, 2004). The dimension of collaborative problem solving in strategic orientation skills, highlights the importance of considering different interests and working collaboratively. This guarantees that the agreed solutions are a mixture of the knowledge determined to still be of value and the knowledge that has been considered by different participants and interests (Carlile, 2004). During knowledge sharing, sometimes a decision can be shaped by the interactions between project participants (Pirzadeh & Lingard, 2017). This indicates that some of the knowledge sharing, especially the outcomes of sharing, are shaped by the interactions between participants. In the end, it's not merely the project manager's knowledge being understood, but more importantly, the shared meanings and solutions being adopted.

Carlile (2004)'s framework draws attention to the differences and transition between each boundary and between each approach. It emphasises the distinct characteristic of each boundary and how the corresponding approach can address the communication and sharing problems associated with them. The integrative framework in the present study draws attention to the interrelation and dynamic nature of knowledge sharing in achieving project success. The present study demonstrates the multi-dimensional and inter-relational nature of knowledge domains in knowledge sharing. The emergent integrative framework not only identifies different knowledge domains but also specific dimensions of each domain. This finding identifies a gap in Carlile's (2004) framework. In Carlile's (2004) framework, the relationships between each boundary and approach are presented at a generic level without specific dimensions or detailed explanations. From this perspective, the integrative framework in the present study

provides more detail in terms of the specific dimensions and relationships between different knowledge domains. This can add to Carlile's framework (2004) in terms of understanding different dimensions of a knowledge boundary and specific relationship between knowledge boundaries.

More importantly, the emergent integrative framework in this research adds to Carlile's (2004) model by revealing and answering the 'how' question, i.e. how to effectively share the knowledge pertaining to different domains or boundaries. The three sets of skills are identified as useful in sharing knowledge pertaining to different domains. This adds and complements Carlile's (2004) model by illustrating what skills are useful in the sharing and how to apply the skills in knowledge sharing. Furthermore, the integrative framework emerged from this research also reveals specific and detailed relationships between the knowledge domains and the skills. The relationships further add to Carlile's (2004) framework by specifying how a skill can help to address a situation or to share knowledge pertaining to a domain.

5.3.2.3 Comparison with Knowing in practice (Orlikowski, 2002)

Orlikowski (2002) highlighted the importance of knowing in practice and the essential role of human action in knowing how to get things done in organisation work. She considered knowing as not being static, but emerging from the ongoing social accomplishments as actors engage in practice. The knowing in practice theory can be compared with both the knowledge domains and the skills in this study.

Knowing, as perceived by Orlikowski (2002), is different from organisational knowledge which is given and stable. Knowing is constituted and reconstituted in everyday practice, and is about what knowledge individuals obtain from practice, and how they do so (Orlikowski, 2002). Thus, knowing is viewed as dynamic and able to evolve through practice. In the present study, the concept of knowledge domains actually covers both its stable and ongoing characteristics. The domain itself is viewed as a fixed and stable property with its own dimensions, and used to differentiate and present the knowledge in a clear manner; whilst the knowledge pertaining to each domain is of a dynamic nature as discussed in Section 4.1.6. In addition, Orlikowskis (2002) suggests that knowledge and knowing can be compared through their conceptual implications –

knowledge as facts, elements, processes and dispositions; knowing as connoting action, doing, practice (Orlikowski, 2002). This highlights the difference between the knowledge domain defined in the present study and the concept of knowing in Orlikowski's theory. Compared to knowledge domains, knowing is more ongoing and closely associated with practice and action; it focuses on obtaining and applying the knowledge in practice.

Orlikowski (2002) goes on to suggest that knowledge, especially tacit knowledge, is a form of 'knowing' and inseparable from action or the context. The findings from this study are consistent with this argument. The knowledge that needs to be shared by project managers is concerned with the 'know-how' and cannot be separated from action or practice; it is based both on reflections of previous work experience and analysis of the current situation.

The findings from this study are also in agreement with the argument made by Orlikowski (2002) that skilful practices used by professionals do not merely consist of applying prior knowledge to a specific decision or action, but are more about being purposive, reflexive and continuous with the ongoing actions and the context in which the actions are constituted. The findings point out that although knowledge pertaining to different domains is vital for the project, the skills, being reflexive and capable of continually sharing the knowledge in project work is even more important for project success.

In regards to knowing and the skills facilitating knowledge sharing, knowing can be viewed as a competency in terms of knowing how to address a situation. The skills that facilitate knowledge sharing in this study are about how to effectively share the knowledge pertaining to different domains. The overall aim of both the 'knowing' in Orlikowski's (2002) study and the skills identified in this research is to solve problems and address situations, in a timely manner, that occur in daily practice. Besides, knowing is recognised as an enacted and provisional capability, and is ongoing, in that it can change when the practice changes (Orlikowski, 2002). This character is similar to that of skills recognised in this study, in that the skills are not merely static, embedded capabilities of project managers, but rather ones which are ongoing, are developed

over time and need to be applied according to specific situations and practice. However, this also implies that the possession of skills that facilitate knowledge sharing does not equate to knowing, but offers the opportunity to consider knowing in the knowledge sharing context.

Orlikowski (2002) identified five types of practice and the knowing constituted in each one, as shown in Table 5.2. The first two practices are about knowing the organisation and the actors in it, which can be seen as 'facts' and a stable form of knowledge. The other three constitute knowing how to coordinate, develop capabilities, and innovate, i.e. knowing 'how to do' is more about individual skills and competency. Relating to the integrative framework in the present study, the five types of practice and the knowing constituted in each practice can be compared to the skills that facilitate knowledge sharing; the knowledge embedded within the according practice can be discussed against the knowledge domains. This is because in Orlikowski's (2002) theory, practice can be considered as a method to enable learning and knowledge sharing; the knowing constituted in the practice involves the actual knowledge being obtained and learned.

Practice	Activities Comparising the Practice	Knowing Constituted in the Practice
Sharing identity	Engaging in common training and socialisation Using common orientation to do development work Identifying with the organisation	Knowing the organisation
Interacting face to face	Gaining trust, respect, credibility, and commitment Sharing information Building and sustaining social networks	Knowing the players in the game
Aligning effort	Using common model, method, and metrics Contracting for expertise annually Using standard metrics	Knowing how to coordinate across time and space
Learning by doing	Investing in individual development Mentoring employees in their careers Rewarding not punishing effort	Knowing how to develop capabilities
Supporting participation	Globally distributing product development work Involving participants in project decisions Initiating and supporting overseas assignments	Knowing how to innovate

Table 5.2: Repertoire of practices, activities and knowing (Orlikowski, 2002)

In particular, strategic orientation skills (see Section 4.2.3) in the integrative framework are largely consistent with Orlikowski's (2002) theory in terms of 'the sharing identity'

to ‘know the organisation’ and the ‘supporting participation’ to ‘know how to innovate’. The practice of sharing identity, initiated through training and socialisation workshops which new employees participate in, enables participants to understand the tacit knowledge about the ‘organisational way’ of doing things. This generates common ground on which members are connected with a set of shared values and goals; whilst highlighting common interests, and also increasing cooperation among members (Orlikowski, 2002). Strategic orientation skills identified from the findings of this study also highlight the necessity and methods to address common interests and to work in cooperation with stakeholders; this dimension is helpful in maintaining coherence and commitment in the collaborative project. The practices of supporting participation can be related to the strategic orientation skills. The practice of supporting participation involves active integration of the distributed expertise and experience through ongoing project or assignment participation, with the aim of generating and sustaining a high level of innovativeness (Orlikowski, 2002). This encourages individuals to share expertise across the organisation and the project. Similarly, the strategic orientation skills identified in this study also highlights the collaboration among project managers and experts in order to achieve project success. Besides, the knowledge being shared in the supporting participation practice can involve both implementation knowledge, and strategic and operational knowledge as presented in the integrative framework.

Interpersonal skills (see Section 4.2.2) in the integrative framework are relevant to the practice of ‘interacting face to face’ to know ‘the players in the game’. Face to face interaction involves intensive social interactions, which enacts an ongoing process of knowing the employees, and thus generates and sustains positive social networks within the organisation (Orlikowski, 2002). Interpersonal skills in the integrative framework also focus on building important social networks to enable efficient support and knowledge sharing. Furthermore, interaction in practice is not merely a way for workers to know each other, but it also assists in breaking the considerable ‘social boundary’ between engineers and managers via affording a knowing and understanding of each other in interactions (Orlikowski, 2002). The ‘social boundary’ is also identified from the findings in this study because a construction project involves participants from distinguished backgrounds including investment, management and

engineering. Interpersonal skills can assist project managers in interacting with and understanding participants from different backgrounds, especially in terms of their credibility and commitment to specific issues. The knowing constituted in the practices, i.e. 'knowing the players in the game', is relevant to knowledge about people as identified from this research. Through ongoing activities of communication and sharing identities, members get to know their co-workers and gain relevant knowledge about the people they work with in terms of their behaviours and expectations.

In Orlikowski's (2002) theory, aligning efforts enables participants to obtain knowing about how to conduct work consistently with others. Through this practice, the implementation of a mutual task among different participants can be effectively accomplished. The knowledge involved in the process is similar to the implementation knowledge (see Section 4.1.3) identified from this study. In the construction project in this research, aligning efforts and consistency are needed among different participating organisations, and implementation knowledge needs to be shared at the right time. Additionally, in Orlikowskis's (2002) theory, learning by doing enables participants to obtain the 'knowing' of how to develop capabilities with the aim of addressing different situations that occur in their work. This is relevant to the knowledge domain of implementation in this study, as the knowledge being shared and understood by participants focuses on solutions towards a certain situation.

'Knowing in practice' draws attention to the significance of mutual constitution between knowing and practice (Orlikowski, 2002). Apart from the specific overlaps between the five categories of Orlikowski's (2002) identification, as presented in Table 5.2, and the knowledge domains and skills in this research as discussed above, an overall consistency exists between the present study and Orlikowski's (2002) theory. The findings from this study point out that knowledge domains and skills that facilitate knowledge sharing are inter-related and cannot be considered in isolation. This is aligned with the argument of mutual constitution between 'knowing' and practice.

The integrative framework in the present study draws attention to the specific relationships between knowledge domains and skills. When relating the five dimensions in 'knowing in practice' to the integrative framework, the framework adds

details to the particular domains of knowledge being obtained and shared throughout the practice. The integrative framework also extends the understanding of 'knowing' through explaining the specific relationships between knowledge domains, as a partial element of knowing, and skills that contribute to the sharing and dissemination of knowledge. Besides, knowledge domains and skills in the present study offer one perspective on how to consider 'knowing in practice' from the point of view of knowledge sharing. The present study highlights the role of knowledge sharing when 'knowing in practice' occurs, and the context of temporal construction projects rather than organisations.

5.3.2.4 Comparison with the Conceptual Framework of Knowledge and Learning in IT Projects (Reich, 2007)

Reich (2007) investigated the knowledge and learning in IT projects, with a focus on the key knowledge areas that need to be managed and the embedded knowledge-based risks within projects.

Reich (2007, p. 8) defined knowledge management in the project context as "*the application of principles and processes designed to make relevant knowledge available to the project team. Effective knowledge management facilitates the creation and integration of knowledge, minimizes knowledge losses, and fills knowledge gaps throughout the duration of the project.*" The principle which underlines this definition aligns with the overall concepts and beliefs that lead the identification of knowledge domains and the skills in this research. Particularly, applying principles and process to make knowledge available to the project team is aligned with the purpose of project managers' skills, i.e. project managers acquiring different sets of skills to effectively share knowledge with project members. Moreover, this definition also highlights the temporary nature of both knowledge and projects, and thus emphasises the need to integrate knowledge from different sources (Reich, Gemino, & Sauer, 2008). The integrative framework in the present study acknowledges both the temporary nature and multi-disciplinary character of the project through the three phases. The project is composed of three organisations from different disciplines working together, temporarily within a limited timeframe. This reveals the necessity of interpreting and integrating different knowledge and understandings.

The present study has identified different knowledge domains; these can be considered as knowledge areas in the context of Reich's theory. The findings from the present study suggest that much of the knowledge, such as strategic business knowledge and knowledge about risk, extend beyond the contextual facts and is more concerned with how project managers interpret and understand these facts and then turn these into actions. Different understandings can result in different decisions or actions. Similarly, Reich (2007) suggests that for some knowledge areas, especially those about organisational structure and values, is more important in terms of how people interpret them than what is written in the organisational documents. Reich (2007) argued that although the interpretations can be different, they are important especially when an external project manager needs to deal with difficult problems and make key decisions with the organisation of the project.

The domain of strategic and operational knowledge from the present study is concerned about the industrial and market context and the business value in project operation. This overlaps with what Reich (2007) defined as 'domain knowledge' and 'institutional knowledge'. 'Domain knowledge' refers to the understanding of the industry, current situation and potential solutions (Reich, 2007). The analysis of the current situation and the industrial context is for the purpose of making strategic decisions and solutions for realising the business value. 'Institutional knowledge' is a mix of organisational history, structure and values, mostly shared via means of stories and observing (Reich, 2007). This area is argued to be important when external project managers need to get difficult problems dealt with and key decisions made with the organisation as part of the project. It highlights the existence and importance of sharing organisational self-interests and project business value.

The other similarity between the results from this research and Reich's theory is the knowledge domain of planning and the 'process knowledge'. Reich (2007) defined process knowledge as the knowing about the project structure, methodology, tasks, and timeframes, which allows the project team to understand each individual role and responsibility in the overall project. This is relevant to the knowledge domain of planning in the integrative framework, as planning knowledge includes understanding how to plan the project delivery in terms of project structure and timeframes. Through

setting up initial structure and timeframes, sharing planning knowledge enables team members to understand 'process knowledge', i.e. their individual position inside the project and generic ideas about what is expected to be delivered.

Besides, an important part of Reich (2007)'s Managing Knowledge and Learning Framework is a categorisation of knowledge-based risks within project context, as shown in Figure 5.3. The researcher will conclude this discussion of Reich's framework by reflecting on the knowledge-based risks in the context of the findings in the present study.

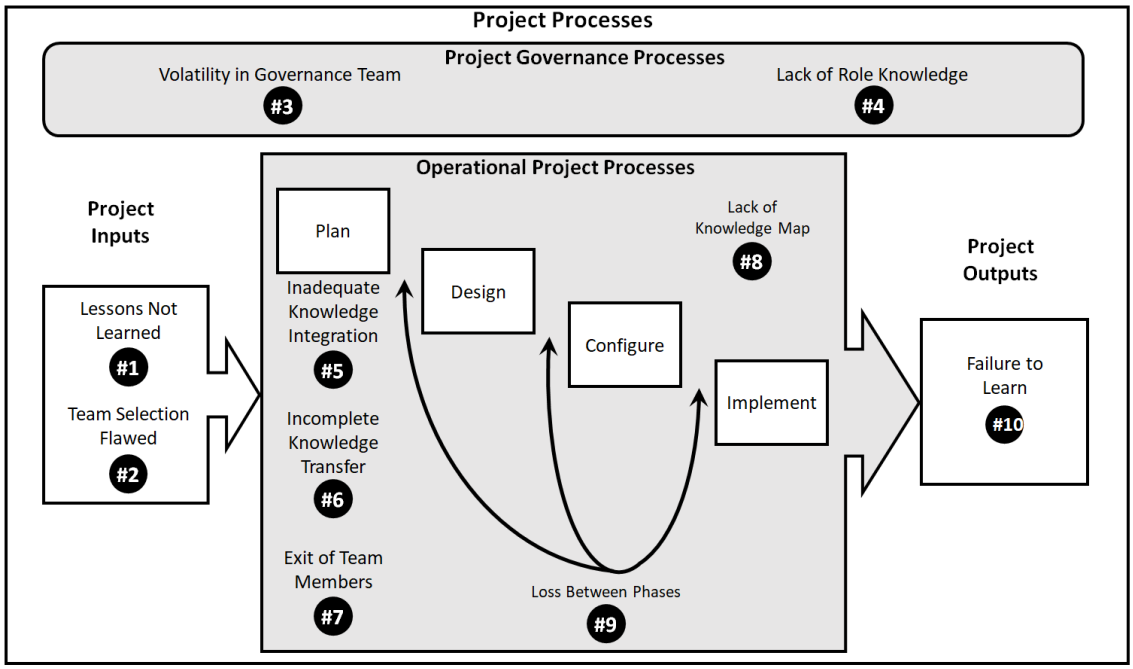


Figure 5.4: Knowledge-based risks in the conceptual framework of knowledge and learning in IT projects (Reich, 2007)

Both the knowledge-based risks in Reich's theory and the skills in this research are derived and driven by the knowledge areas/domains that need to be shared. The identified risks point to the necessity of developing and applying relevant skills that facilitate knowledge sharing, and the application of these skills help to address the risks. Additionally, in Reich's framework, the risk part is associated with different

phases of a project; the knowledge domains in this study are also discussed together with different project phases.

As shown in Figure 5.3, the #1 Risk of lessons not learned implies a lack of reflection on prior projects and work experience. Similarly, the #10 failure to learn leaves fragmented ideas and thoughts in terms of why things went well, or not so well. These two risks are linked and can be addressed by social cognitive skills, particularly the analytical skills, via equipping project managers with reflection and reflectivity capabilities to analyse prior experience and the current project situations, and thus generate sufficient knowledge to share with relevant members. The #5 risk of inadequate knowledge integration refers to difficulties in sharing cross-functional forms of knowledge and different forms of specialist knowledge, especially across technical oriented, and business oriented team members (Reich, 2007). This risk is relevant to the social cognitive skills in the way that social cognitive skills assist in interpreting different understandings towards specific knowledge or situations and achieving the shared meanings in the project team. Specifically, the clarification and articulation skills help to express and explain professional knowledge in a clear manner and integrate the knowledge between project members. The lack of a knowledge map labelled as #8 refers to the risk of not being able to document or visualise the knowledge to be possessed by all members when making interrelated decisions. Documenting and visualising knowledge is difficult to do; however, the clarification and articulation skills can help the participating members to understand the knowledge being shared, and the skills of selecting appropriate tool and place for sharing knowledge can better support the clarification process.

The risks of #6 incomplete knowledge transfer and #9 loss between phases point to the miss-communication and reluctance in sharing. This is related to the interpersonal skills in the emergent theory that being able to communicate, build and sustain positive relations, and avoid conflicts can help to avoid the miss-communications in knowledge transfer and in across-phase situations. Furthermore, positive relations can help to reduce the extent of reluctance from individuals. The strategic orientation skills appear to be useful to the human resource related risks of #2, #3, #4 and #7, in the ways that effective leadership skills can develop understandings and make better decisions in

human resource selection and that collaborative problem solving skills assist in addressing difficulties jointly when there are changes in project members. This also links to the necessity of sharing the knowledge domain of people.

One of the main differences between Reich's (2007) framework and the integrative framework in this study is that in Reich's framework, the three components (i.e. definition, knowledge types and risks) are presented separately without identifying the linkages between them; the integrative framework however, demonstrates the specific relationships between the knowledge domains that need to be shared and the skills that contributing to the sharing. This constitutes one of the contributions that the integrative framework brings to the existing knowledge.

5.4 Summary and implication for research

This chapter aims to provide an in-depth discussion about the findings from this study. To achieve this, it begins with discussing the specific relationships between the two parts of the findings (presented in Chapter 4 Findings), i.e. knowledge domains and skills contributing to knowledge sharing practice. This is supported by both the data from this study and relevant literature.

The emergent integrative framework revealing the knowledge domains, skills, and their relationships within the research context is presented in Section 5.2. The integrative framework contributes to the literature in three perspectives. Firstly, it illustrates the dynamic nature of the knowledge domains and dynamic application of skills, which contributes to understanding the collective and interactive process within a construction project. Furthermore, the framework indicates the relational nature between knowledge domains and skills. The sharing of knowledge domains and the application of skills are inter-connected and do not operate independently of each other; they influence and reinforce each other mutually. Thirdly, the knowledge domains, skills, and their relationships are open to different interpretations and understandings on the basis of the various positions of stake-holders within the project.

To further discuss the findings from this study in relation to the existing literature, Section 5.3 provides two levels of comparison: comparing different parts of the

findings against the literature, and comparing the integrative framework as a whole against exiting models and frameworks. The comparisons suggest that different parts of the findings, such as a certain knowledge domain or a set of skills, have over-laps and are consistent with corresponding studies in the literature. More importantly it also suggests that this study provides a new perspective on skills contributing to knowledge sharing through its integrative approach in discovering knowledge domains and skills, and the specific relationships between them.

In summary, the four research objectives are achieved and therefore, the research question is successfully answered. The next and final chapter concludes this study with an explanation of how it offers a novel contribution to knowledge.

Chapter 6: Conclusion

6.1 Contribution to knowledge

This research is aimed at identifying skills that support project managers in their knowledge sharing practices in the context of a construction project. Despite the existence of a large volume of literature regarding knowledge sharing, it seems that the field has not investigated in detail the individual skills that enable knowledge sharing practices, especially for the specific role of project managers working in the construction industry. The research question was established as: What skills contribute to effective knowledge sharing for project managers in construction projects? In order to answer the research question, four research objectives were formulated.

With regards to the first research objective of identifying and exploring different domains of knowledge that project managers need to share in their practice in the construction industry, the research has identified five knowledge domains that need to be shared. These include knowledge of risk, planning, implementation, people, and business strategies and operations (see Section 4.1). These differ from previous categorisations that were synthesised in Table 2.3 and Figure 2.11, and contribute to a novel categorisation of knowledge domains in the construction project setting. In addition, the research demonstrates that the five knowledge domains are largely aligned with the three phases of the project lifecycle, and are of a dynamic and inter-relational nature. Knowledge pertaining to the five domains constantly constitutes and accumulates as an ongoing accomplishment with the evolvement of the project; sharing the knowledge requires a dynamic stance, in that knowledge pertaining to different domains needs to be constantly shared in a timely manner to address different situations within the project. Although the five knowledge domains are each focused on one type of knowledge, they are interconnected through the overlaps between different dimensions of the domains. Furthermore, some domains are more prevalent in certain phases than others. For instance, knowledge of planning needs to be shared more constantly than knowledge of implementation in the first phase due to the phase requirements. In addition, the knowledge domains are open to different perspectives and interpretations, as they are constrained and introduced by individuals

who hold different positions within the project. The identification of knowledge domains served as the prior step to achieve the second research objective.

In terms of the second research objective, focused on identifying and exploring different skills that support project managers to share the required knowledge, the findings suggest three sets of skills that contribute towards the sharing of the identified knowledge domains and need to be applied by construction project managers (see Section 4.2). The first set of skills, social cognitive skills, is concerned with reaching mutual understandings among project participants; the second set, interpersonal skills, contribute towards creating a positive environment within the project for knowledge sharing; and the third set of skills, strategic orientation skills, support project managers in strategically reaching agreements among participating organisations and stakeholders within the project. This categorisation of skills differs from previous studies that were synthesised in Table 2.5 and Figure 2.11, and provides a novel and detailed explanation of skills that contribute to knowledge sharing practice based on the identification of the knowledge that needs to be shared. Moreover, the research illustrates differences in 'levels' with regard to the applications of the three sets of skills. Social-cognitive skills are applied when the differences in knowledge are at an individual level between project members. Interpersonal skills are also focused on an individual level of knowledge sharing but with the purpose of creating a positive project environment. Strategic orientation skills are applied at an organisational level, focusing on and addressing situations where differences and conflicts in interests occur between participating organisations and stakeholders. In addition, the three sets of skills are inter-related in a way that the dimensions of different skills sets can overlap in terms of addressing similar type of situations within the project; this inter-related nature indicates the importance for project managers to develop and apply these three sets of skills in a comprehensive manner. Furthermore, as the three sets of skills contribute to share knowledge pertaining to the knowledge domains and the knowledge domains are of a dynamic nature, the application of skills is also dynamic according to the needs of different situations. Finally, the three sets of skills are open to different interpretations and perspectives for various organisational positions within the project.

The third objective concerned establishing relationships between the skills and knowledge domains. The skills and knowledge domains are interconnected through specific relationships and interactions (see Section 5.1). Social cognitive skills are particularly useful in sharing knowledge about risk, planning and implementation; interpersonal skills are relevant to the domains of implementation, people, and strategic and operational knowledge; strategic orientation skills assist project managers in sharing knowledge of planning, implementation, people, and business strategies and operations. The identified relationships not only describe which skills are useful in sharing a knowledge domain, but also specify what dimensions of those skills are helpful in the sharing. This contributes to knowledge through extending the understanding of interconnections between skills and the knowledge that need to be shared. Furthermore, the knowledge domains and skills are mutually influenced. There are mutual interactions between knowledge domains and skills, and they cannot be considered in isolation. For instance, applying certain skills to share knowledge effectively can encourage the knowledge receivers to respond to the topic; this in return helps the project manager to obtain new knowledge and insights. In addition, the relationships between skills and knowledge domains are of a dynamic nature and open to different interpretations. To share a domain of knowledge, different sets of skills are needed, and one set of skills can be applied in sharing knowledge pertaining to different domains; the interactions between a knowledge domain and a set of skills are dynamic according to different situations, and are open to various perceptions and positions within the project.

Finally, the fourth research objective concerned the development of an integrative framework to conceptualise and explain the relationships between skills and knowledge domains. The integrative framework (see Section 5.2) conceptualises the results from the above objectives and relates them within the context of the three phases of the construction project. The integrative framework illustrates that the project is an interactive process consisting of dynamic sharing of knowledge and dynamic application of skills. This extends the understanding of 'knowing' from the perspective that knowledge sharing is an ongoing activity with knowledge domains and skills being constituted and reconstituted as project managers engage with the project

work. Furthermore, the integrative framework suggests a relational nature of the knowledge sharing process, as the knowledge domains and the skills facilitating knowledge sharing operate in a dependent manner. These two entities are closely related through the specific relationships as indicated in the framework. This is a novel perspective, as in the current literature investigation into knowledge domains and skills from an integrative approach is very limited. Additionally, as the sharing of knowledge and application of skills are constrained by individuals working in different participating organisations who hold distinguished positions and priorities within the project, the integrative framework is also open to different understandings and interpretations.

6.2 Theoretical implications

The contributions to knowledge, as discussed in the above section, are further converted and connected to theoretical implications in this section.

The first implication is that this research identifies the knowledge domains and skills contributing towards the knowledge sharing in an integrative manner and combines them within one construction project. This proposes a novel integrative approach to identify skills that facilitate knowledge sharing, and provides an integrative understanding towards the skills and their association with the knowledge domains that need to be shared. Integrating these two dimensions has not been conducted in previous studies; skills contributing to knowledge sharing have not been formulated in this integrative way in the current literature. As discussed in Chapter 2 and indicated by the tentative framework in Figure 2.11, most of the existing studies focus on either knowledge domains or skills enabling knowledge sharing separately rather than an integrative approach. The limited number of studies (e.g. Hwang & Ng, 2013) identified in the literature review that combine these two dimensions are conducted through quantitative methods; they focus on measuring and quantifying the priorities for the knowledge domains and skills at a generic level, rather than an in-depth exploration of how they manifest themselves in an empirical context or providing an explanation about how they relate to each other. In this research, the knowledge domains are identified and comprised of different categories that need to be shared; this identification acts as the first step to further identify skills that contribute to the sharing of them. Therefore, the skills in this study, containing different foci and

dimensions, are explored and identified based on the knowledge domains and serve the purpose of sharing the knowledge pertaining to these domains. This contributes to a more integrated understanding of project managers' knowledge sharing practices, from the perspective of skills within the context of a construction project.

Building up on the condition of an integrative approach, the second implication is the dynamic nature between the two different dimensions of the integrative framework. The integrative framework provides insights into the dynamic interactions between the knowledge domains and the skills facilitating the sharing of knowledge within the three-phase construction project. As indicated from the literature review, studies about project management have examined skills for project managers from a variety of perspectives, but rarely from a knowledge sharing aspect. In knowledge management research, many studies have categorised different types of knowledge within a research setting (e.g. Hu et al., 2015) but not related them to skills that facilitate the sharing. The dynamic interactions between knowledge domains and skills, revealed by the integrative framework in this study, can provide a new perspective to explore the dynamic nature of knowledge sharing for future research. In addition, the dynamic nature between knowledge domains and skills in this study is largely aligned with Orlikowski's (2002) theory of the dynamic interactions between knowing and practice. This research extends the understanding of knowing as a dynamic process, from the perspective of obtaining knowledge and applying skills to share the knowledge within the specific context of a construction project.

The third implication is that knowledge domains and skills have an inter-relational nature. The integrative framework in this study not only describes the key categories of knowledge domains and skills, but more importantly, illustrates the specific connections and interactions between them. As uncovered by the literature review, most of the studies investigate knowledge domains and skills facilitating knowledge sharing in separation; this limits the understanding of the complex relationships between them. The integrative framework proposed by this study helps to address this limitation by providing an insight into the specific relationships and interactions between the knowledge domains and construction project phases, and between the knowledge domains and skills. It provides a detailed explanation in terms of which

skills contribute to share which domain of knowledge, and what particular dimensions of the skills are useful in the sharing. Because the relationships have not been proposed in the previous literature and are grounded in project managers' knowledge and experience through their participation in the construction project, it is argued that the identification of the specific relationships between knowledge domains and skills contributing to knowledge sharing constitutes a third theoretical implication.

The fourth implication refers to the multiple perspectives and interpretations that are brought along by the positionality of different actors and stakeholders. The results of this study are grounded on and constrained by individuals that belong to different organisations and hold various positions and interests within the project. As different actors understand, experience and explain the knowledge domains and skills in different ways, the results of this research are open to different understandings and interpretations. For example, project managers from the investing company place more emphasis on the knowledge domain of business strategies and operations and on leadership skills, due to their investing and leading position within the project. This opens up further theoretical implications concerning the positionality of actors within a project and the mutual influences between their positionality and the knowledge sharing practice.

6.3 Practical implications

The study presented in this thesis is aimed at identifying skills contributing towards knowledge sharing by project managers in the construction industry, and assisting them in their knowledge sharing practices. In addition to the skills, it also contributes insight into different knowledge domains that need to be shared in construction projects, together with the specific relationships between the knowledge domains and the skills. The results of this study can be put into practice by project managers and their associated organisations as described in the following paragraphs.

The first practical implication is with regard to the knowledge domains. Project managers in the construction industry should place importance on the variety of knowledge domains, being aware that there are different types of knowledge that need to be shared throughout the project. They should also be aware that it is

important to share certain domains of knowledge at certain phases of the project, as each knowledge domain has intensified usage and importance for relevant phases.

The second practical implication arising from this study refers to skills that contribute towards the knowledge sharing. Project managers can perform a self-assessment of their skills based on the integrative framework presented in this study. They can evaluate the skills they have and identify potential skill gaps that they need to address, in order to 1) enhance individual competitiveness, 2) enable better knowledge sharing practices, 3) perform managerial roles more effectively, and 4) increase the possibility of project success. Furthermore, project managers should be aware of the relationships between knowledge domains and skills. The relationships illustrated in the integrative framework can assist them in applying relevant skills to share knowledge pertaining to different domains. In addition, any organisational entity involved in construction projects (i.e. investing companies, design institutes and construction companies) can utilise the integrative framework to identify training needs to their project managers, as well as to understand the reasons about how knowledge can be better shared through the application of different skills.

The third practical implication pertains to the multiple perspectives towards knowledge domains and skills identified in this study, which require specific awareness from project managers. Differences in perspectives and interpretations indicate the positions and focuses of each organisation within the project. This can potentially assist project managers and provide them with guidance in terms of effective negotiation and the successful evolution of the project. Furthermore, the findings in terms of multiple perspectives from this study can be useful and valuable to other project contexts that involve multiple organisations, such as smart city projects (that always involve different government departments, service organisations and Information Technology firms) and smart manufacturing projects (that involve the manufacturing company and other hardware, software, and consulting firms).

6.4 Limitations and directions for future research

The limitations of this research are reflected in four perspectives. To address the limitations of this research, four corresponding directions have been identified which future studies can further explore.

The first limitation is that this study followed a snapshot approach. The data collection took place directly after the case project was completed; the reasoning behind this was that project managers would have fresh and accurate memories and obtain a comprehensive perspective towards the project when responding to the questions during interviews, as explained in detail in Section 3.2.4.2. A different way to research this in future would be to conduct a longitudinal study that captures the dynamics of a live project.

Secondly, this study is conducted within a context specific research setting. It aims at exploring the case project and generating an integrative framework that is applicable to the case project. A typical concern regarding a single case study design, acknowledged by Yin (2003), is that it provides limited basis for scientific generalisation. Yin (2003) responded to this limitation that *"(case studies) are generalisable to theoretical propositions and not to populations or universes. … not to enumerate frequencies (statistical generalisation)* (p.10)". Strauss and Corbin (1998) also suggested that Grounded Theory is aimed at generating a substantive or formal theory that "*is developed from the study of one small area of investigation and from one specific population, specifically for the populations from which it was derived and to apply back to them* (p. 267)". The categorisations of knowledge domains and skills in this research can provide insights into relevant knowledge sharing issues in other construction companies in the context of China. Some categories are likely to be applicable or transferrable through further investigation and with careful consideration with the particular context. The integrative framework in this study can also be beneficial for other researchers in areas of knowledge management and project management; it serves as a base for future studies. While the emphasis on specific domains and skills may change in different contexts, the core properties of the framework, for example the mutual influences between knowledge domains and skills are likely to be transferrable. An interesting development would be to explore this in different project

management contexts beyond the construction industry, such as in smart city and smart manufacturing projects that involve essential interactions and collaborations across multiple organisations.

Cultural aspects did not come up strongly from the findings in this study, the main reason being that this research is focused on project managers' skills rather than the contextual issues. An interesting direction would be to conduct this study with a strong focus on the cultural characteristics that are specific to the context.

Another limitation is the fact that this study is focused on a project management perspective. The results of this research are constrained by, and pertain to, the perceptions of project managers. Further research could explore this from the perspective of multiple actors that are part of the project.

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Appendices

Appendix 1: A sample of interview schedule for project managers in the design institute

Section 1: General research context

1. Can you please generally introduce your role and your team/department in this project?

您能介绍一下您在辰光酒店项目中的工作职责，以及您所在团队／部门在这一项目中的工作职责吗？

Trigger question:

What work/tasks does your role involve?

这个工作具体有哪些内容？

How many people are there in your team?

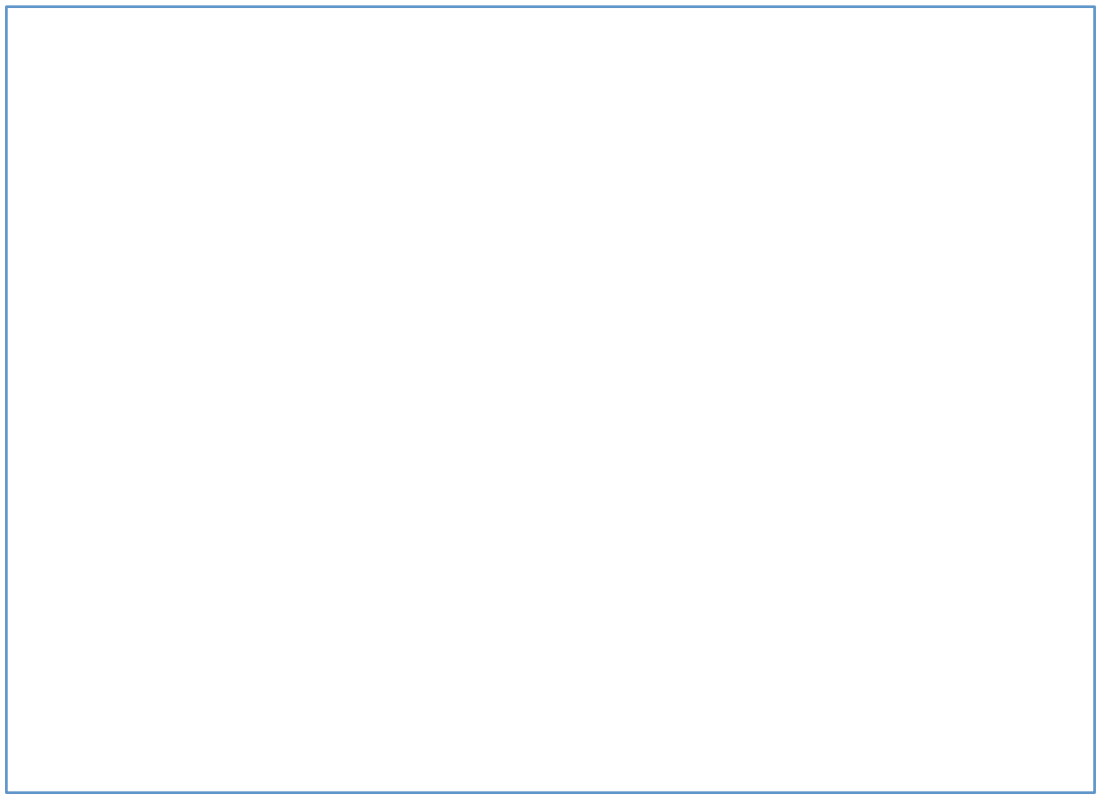
您的团队里有多少人？

What are the roles and tasks of your department/team?

您的团队都负责哪些工作？

How do you interact with the other two institutes?

您和其他两个公司（投资,施工）有联系吗？



Section 2: Knowledge domains

2. In your participation, in order to compete the tasks and goals of your group, can you recall some notable situations where you find communication and knowledge sharing important?

项目中，为了完成团队任务，您有哪些信息和知识需要和其他成员沟通与分享？能否举几个例子或情形？

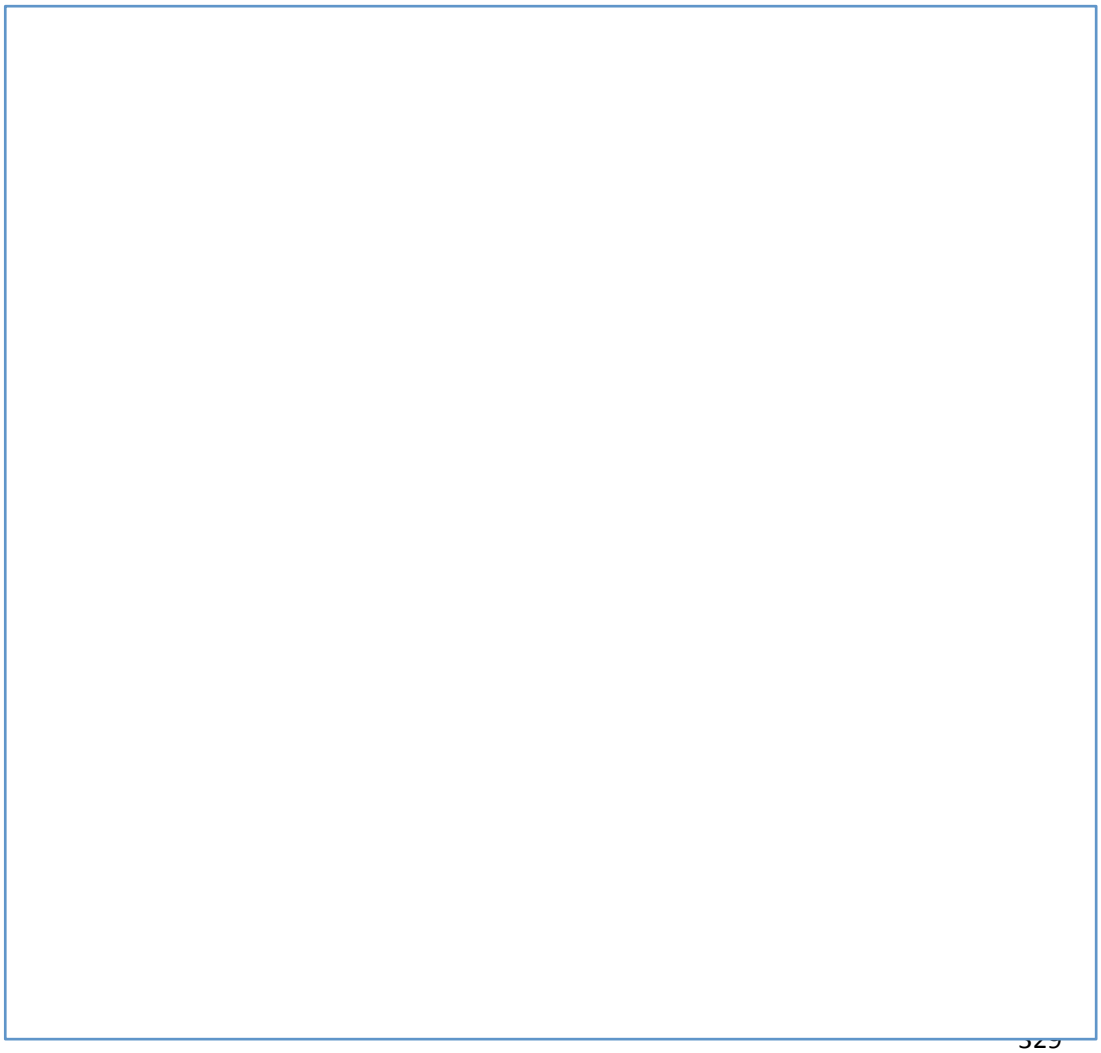
Prompts:

What information and knowledge did you share with others?

您和他人沟通了哪些方面的信息和知识？

Did you share any knowledge relating to your previous work experience in that specific context?

您有没有什么场合，需要分享和您之前工作经验相关的知识？



3. Were there any critical or difficult situations in the project? For example, situations such as problems happened or some changes in project plan, process or organisational policy.

项目进行中有关键或困难的时刻吗？比如遇到难题，项目计划变动，或公司政策变动等.

Prompts:

What types of knowledge being shared that you found helpful in making others understand the situation and in solving the problem?

在当时情境下，您觉得哪些信息和知识的分享会有助于团队成员明白处境和解决问题？

Was there any knowledge shared that related to your previous work experience in that context?

分享的信息知识中，有和之前工作经验相关的内容吗？

4. Do you need to communicate and share knowledge with people outside your team, such as other project managers and senior managers, either in your organisation or the other two institutes? If so, can you give some examples?

您需要和您团队外的人员沟通吗？如其他项目经理，上级经理，投资方和施工方。

Prompts:

What types of knowledge do you share?

您需要和他们沟通哪方面的信息知识？

If the project can be re-conducted, what would you preferred others to share with you? What would you share with others?

若项目能重新进行一次，希望他人可以和您分享哪方面的信息知识？您对其他人呢？

Section 2: Skills contributing to knowledge sharing practice

5. What are the processes you typically follow when you need to share your knowledge with your team members in terms of project developments, plans and directions? (reminder: ask about the other two institutes)

当您需要和其他成员交流有关项目发展和计划的问题时，一般通过哪些途径和方式？（提醒：包括投资方和施工方）

Prompts:

What do you find useful in recognising your team members' attitudes and requirements towards the knowledge that you shared?

怎样能够发现成员对于接收到的信息知识的态度，以及他们的需求？举例？

How do you react in order to respond to their attitudes and requirements?

发现他人的态度和需求后，您认为怎样反应和应对才能更好的分享信息和知识？

How, in your view, would encourage and motivate them in applying the knowledge?

您觉得怎样有助于鼓励成员应用他们分享到的知识？

6. Were there any difficult KS situations happened in the project?

项目中有没有信息知识分享困难或不顺利的时候？

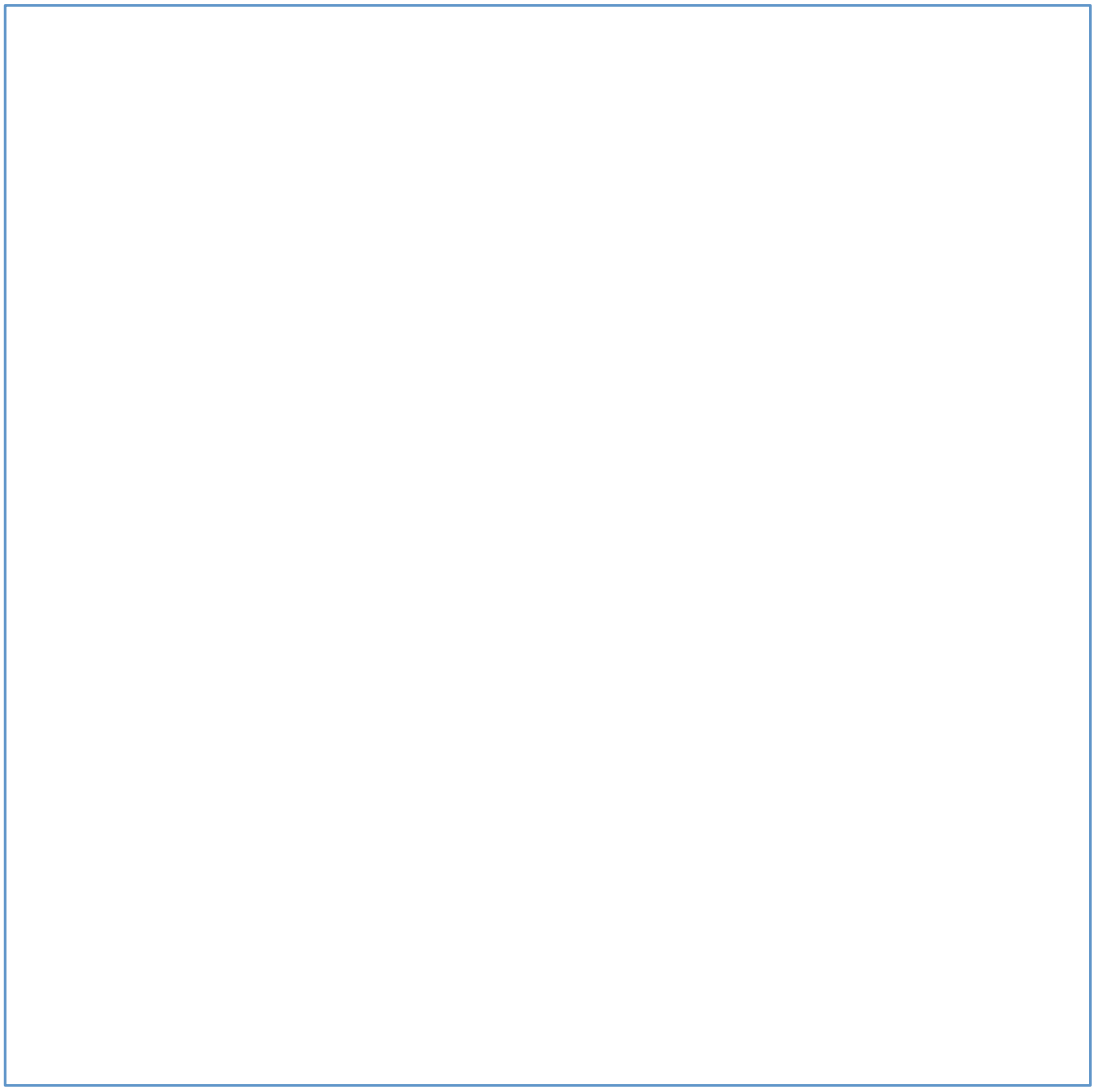
Prompts:

How did they solve the difficulties?

他们怎样解决的？

How do you think the difficulties can be solved?

您认为可以怎样解决？



7. When there is a need to communicate complex information or situation with others, for example, between or among your team member, other project managers and senior managers, what paths do you think can be helpful in understanding others and making the knowledge understood?

当需要沟通交流复杂的信息和情况时，您认为怎样有助于他人明白？怎样做有助于您明白他人的想法和需求呢？

Prompts:

What do you think is helpful or how would you prefer in reading other people's reaction and body language?

您觉得怎样有助于读懂别人接收信息时的反应和肢体语言？

What can help the person who shares knowledge be understood by others?

分享信息知识时，您认为一个人怎样做有助于被接收信息的一方理解？

When given different ways such as official meeting and private face-to-face talk to achieve your goal of communication, how do you decide which path to follow? Which way do you prefer, and why?

当可以选择不同途径分享知识时，如会议，私下面对面沟通，您怎样选择用哪种途径？您更喜欢哪种？为什么？

8. When there's a need to share knowledge with other groups or organisations, how do you and other project managers attain cooperation from them? (reminder: the other two institutes)

当需要和其他团队或公司交流信息知识时，项目经理通常怎样争取他人的配合与合作？

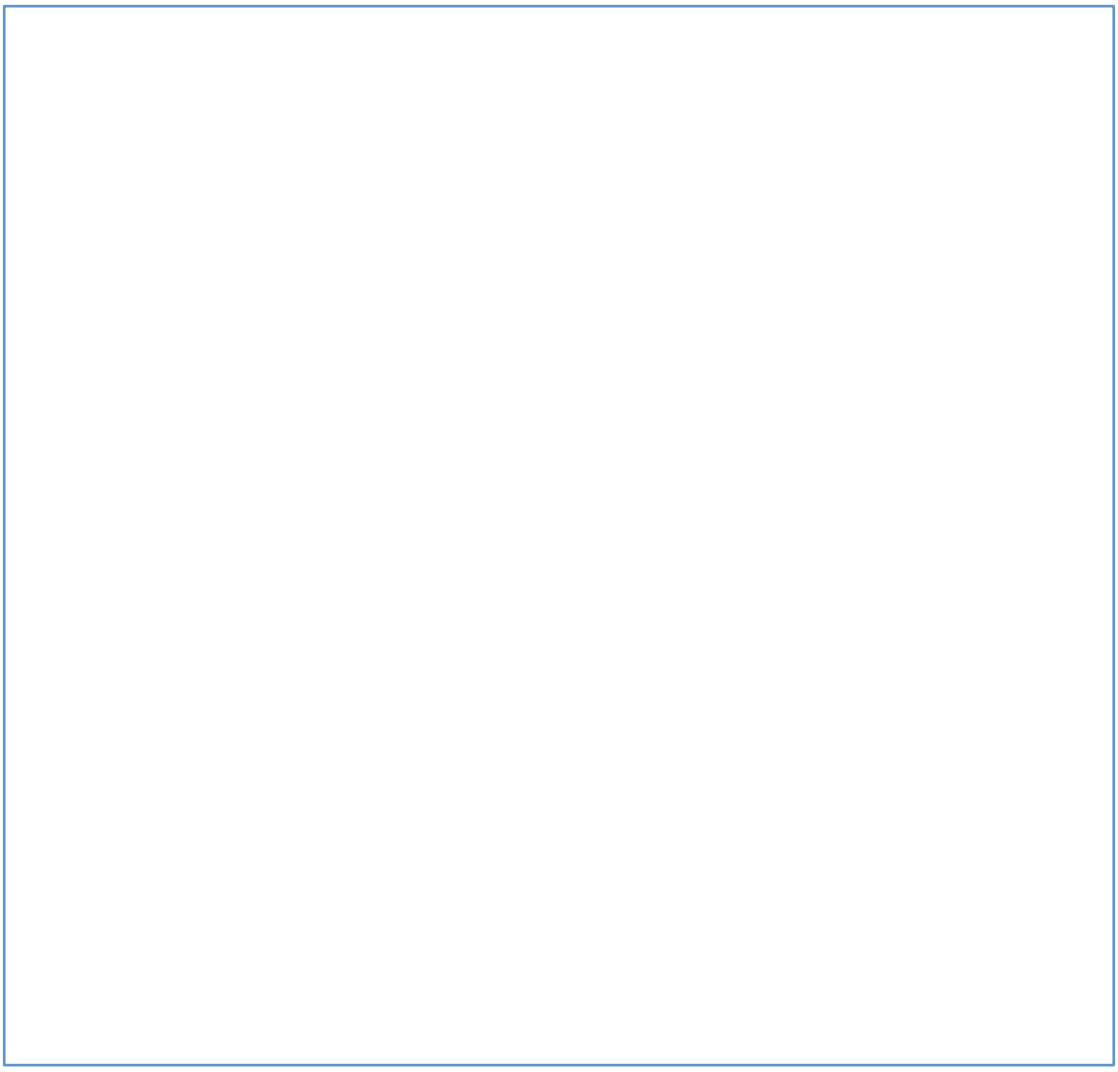
Prompts:

How to maintain relationships that you think helpful for sharing knowledge with others?

怎样维持关系和联系会有利于信息知识的沟通交流？

How to negotiate with them when there was a disagreement?

当双方有不赞同的地方时，怎样和他们沟通交流？



9. Can you recall some memorable situations where project managers successfully applied skills to share knowledge? For example, they successfully recognised others' attitudes and requirements, or encouraged others in applying the knowledge that they shared, or communicated complex information and situation with others, or obtained cooperation with others to share knowledge. (Reminder: project manager can be you or others) (can involve the other two organisations as well)

您能回忆一些场景，项目经理们成功应用他们的知识分享技巧吗？例如项目经理很好辨别他人的需求和态度、鼓励他人应用获得的信息知识、交流复杂信息知识、同他人取得合作等。（注：投资方、施工方也可考虑）

Prompts:

What is the particular dimension about that skill do you think helped and facilitated the sharing?

这个技巧的哪些个特定方面，您觉得对于那次知识分享非常有效？

Were there any efforts being made to apply the skill or to share the knowledge?

项目经理有没有为了完成分享，或者为了使用那个技巧，做出一些努力？

10. Can you recall some situations during the whole project where it is very difficult for project managers to apply their KS skills? For example, when they tried to recognise others' attitudes and requirements, to encourage others in applying the knowledge that they shared, or to communicate complex information and situation with others, or to obtain cooperation with others to share knowledge. (Reminder: project manager can be you or others) (can involve the other two organisations as well)
您能否回忆一些项目经理没有运用知识分享技巧的例子？

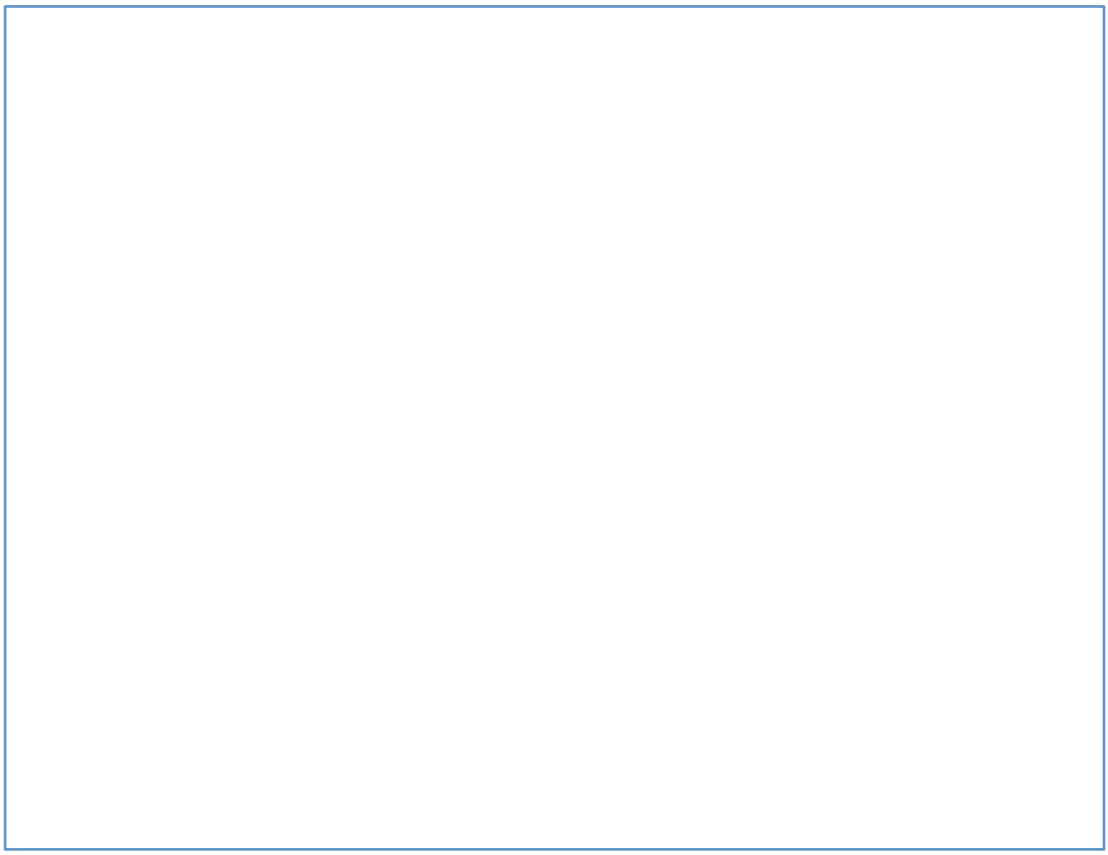
Prompts:

What are the types of knowledge that could have been shared if the skill is applied?
如果当时运用技巧分享了知识，您觉得哪些知识会被分享到？

What other skills do you think that can be or should have been used in that situation?
当时那种情况，您觉得有哪些技能其实可以用到或者应该被用到？

11. So you've been talking for 1 hour, in your view, what other things of KS or KS skills would you want to add that we didn't cover in our conversations?

出来我们讨论的这些问题，对于知识分享和知识分享技能，您有哪些我们没有涉及到、想补充的？ / 您觉得一个理想的管理人员应该具备哪些知识分享技能？



Appendix 2: A sample of 'code definition list'

No.	Code	Definition
1	Awareness of potential difficulties in blueprint changes	Knowledge and awareness of potential difficulties when the construction blueprints need to be partially changed. *The changes can occur in two situations: there is a mismatch between different functional areas in the construction blueprints (designed by the architecture design company but discovered by construction groups); and some parts of the blueprints cannot be practically conducted in the actual construction work. This needs PMs from the three companies to share their understandings and seek for a solution.*
2	Skill of overcoming difficulties in blueprint changes	Able to know how to overcome difficulties and seek for solutions when the construction blueprints need to be partially changed.
3	Skill of cross-functional thinking throughout construction phase	Able to have knowledge and understanding about all different functional areas, and consider all different functional areas when their own area is under construction (for PMs from investor). *This helps to share knowledge of overcoming difficulties in blueprint changes (and his concerns) with relevant construction groups.* *Also helps sharing knowledge area "understanding for different construction groups".*
4	Knowledge of guiding, monitoring and checking construction work	PMs from the investing company need to guide, monitor construction groups' work during construction, and check construction quality after they complete. These processes and inside knowledge need to be shared on time.
5	Potential influences of different construction plans	Awareness, analysis and conjecture of influences that different construction plans can potentially have on construction work.
6	Understanding of different construction plans	Personal understanding and assessment on different proposed construction plans, including audit opinion (审核意见)and answers to difficult technical questions. There are more than one plan for each functional areas.
7	Clarification and articulation skill	Skill of clarifying advantages and disadvantages for different plans or ideas, and articulating these to report to senior managers and share with others.
8	Be ready to answer questions (about construction blueprints)	Skill of always being ready to answer questions and issues in the construction blueprint when it cannot be understood by the Construction groups.

Appendix 3: A sample of 'quotation list'

Sub-Category	Code	Definition of Code	Quotations
Positive relation building and sustaining skills	Skill of out-of-work socialisation	One person (PM) treating others dinner after finishing work is viewed more than only a social activity in the Chinese culture. It can help to gain personal prestige and leadership via informal and personal communication during the dinner time. PM can also explain themselves better if any strict rules or problems happened before.	该关心的还得关心，我这还比较关心下属的。累啊或干什么啊，我有时候掏钱包搓一顿儿，沟通沟通。完了也会说前一段脾气不好啊什么啊，跟下属在吃饭当中有意识无意识就说了， 他们也会理解。 We need to show care for team members. I tend to show my care. If the work is tiring sometimes, I would treat them dinner using my own money, and we can communicate. If my attitude wasn't good earlier, I would mention it during the dinner and they would understand. 平常的时候呢，我们要求我们不允许在一起去吃他们的饭，但是他们提前完成任务的时候我们来请他们吃饭. Usually we require our team members not to have dinner with them. But if they complete construction work on time, we would treat them dinners. 经常沟通，一定要跟他们像朋友一样，一定是这样。不这样否则的话他会很敌对你，很麻烦。否则的话他会很敷衍你，比方说设计师来，我几乎来了后每次我都陪他喝，都陪他们吃喝，反正我有这个权利嘛可以签字，但是我每次要请他吃饭，像朋友一样，他会跟你交心，会帮你出很多主意。假如说，说你穿这个衣服说绿色，这绿色多了，他有八种绿，哪个绿，他不告诉你，他不会说。但是你要是跟他交朋友，他会给你提供一个色样。就是说装修它是软饰这块非常厉害，包括壁纸，包括窗帘，他会给你提供一个小样。如果你不跟他交朋友话，他这个材料回扣就少不了。提供东西他用他这个，他坚持住他就报备了，报备以后你就不能再进了、就得通过他，然后他拿回扣。如果你这个东西报备了，我可以不用，我可以用别的东西可以替代它，就无所谓了。这样对施工也好对咱们资金也好，都有好处。I (investor) need to treat them (design) as friends. It must be like this; otherwise it can be troublesome that he doesn't tell details. For example every time when the design person comes, I would have dinner with him as I can sign the dinner on behalf of the company. But I need to treat him dinner as friends, and in that way he can have conversations with me and help me with many ideas and suggestions. For example you wear a green colour clothes, there are eight types of green, which green colour exactly it should be, he would not tell. But if you are friends with him, he would provide you colour samples. Interior fixture is quite soft, including wallpapers and curtains, he can provide you samples. If you don't make friends with him, he can receive commission or kickbacks from suppliers for the materials. ... So this is good for our construction and our investment.
	Skill of avoiding contradiction	Skill of avoiding contradiction and building harmonious working environment, especially for inter organisations. This helps to avoid KS bias and promotes KS activities in general.	人和人之间会有感情，这种感情（发展）了以后，有时候他就不会专门给你制造一些矛盾。如果他跟你关系不好的话，就会给你制造一些矛盾。关系好的话，他就把自己的矛盾，他就想办法解决了. People have emotions in between, and when this emotion develops they won't make troubles or conflicts. If the relationship between you and them is not good, they might make some trouble on purpose. If the relationship is good, even if there is trouble or conflict they might solve them on their own.

Appendix 4: Approval Letter for Ethics

Downloaded: 12/06/2018
Approved: 15/07/2015

Shuyang Li
Registration number: 130255839
Information School
Programme: INFR33 PhD/Info Studies (Social) FT

Dear Shuyang

PROJECT TITLE: Critical Knowledge Sharing Skills of Project Managers in the Chinese Construction Industry: A Case Study
APPLICATION: Reference Number 002675

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 15/07/2015 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 002675 (dated 14/07/2015).
- Participant information sheet 1011359 version 1 (14/07/2015).
- Participant consent form 1011360 version 1 (14/07/2015).

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Yours sincerely

Matt Jones
Ethics Administrator
Music

Appendix 5: Information sheet

The University of Sheffield. Information School	Knowledge Domains and the Skills that Facilitate Knowledge Sharing in Project Management – A Case Study in the Chinese Construction Industry

Researchers

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Purpose of the research

This study aims to identify skills that contribute to knowledge sharing and are required by project managers in construction projects in China, to develop a framework of knowledge sharing skills.

Who will be participating?

Your participation in this study is required in your role as 1) staff performing managerial roles at the case project where this study is conducted, or 2) staff directly interacting with project managers at the case project.

What will you be asked to do?

The participation in this study entails engaging in a semi-structured interview with the purpose of understanding project managers' knowledge sharing skills and the factors that act as barriers or enablers to project managers' knowledge sharing in the context of construction projects. The interview will develop via face-to-face communication and each interview should not be longer than 60 minutes. It will be recorded via digital voice recorder.

What are the potential risks of participating?

The risks of participating are the same as those experienced in everyday life.

What data will we collect?

We are only collecting your responses to the interview questions. No other data will be recorded.

What will we do with the data?

After the interview, the recording will be transcribed into Word documents and fully anonymised, as any reference to participants' identity will be eliminated. Additionally, all information disclosed in the interview process will remain strictly confidential. The interviews but not the names of interviewees will be recorded and transcribed, with all records being kept for a period of 3 years with the researcher or the project supervisors in a secure place. After this period all transcripts will be destroyed.

Will my participation be confidential?

The data will be collected with no identifying information attached.

What will happen to the results of the research project?

The results of this study will be included in my PhD Thesis. Results will be retained for a period of 3 years, during which they can be used for publication in academic journals, books and conference papers.

Appendix 6: Participant Consent Form

The University of Sheffield. Information School	Critical Knowledge Sharing Skills of Project Managers in the Chinese Construction Industry: A Case Study

I confirm that I have read and understand the description of the research project, and that I have had an opportunity to ask questions about the project.

I understand that my participation is voluntary and that I am free to withdraw at any time without any negative consequences.

I understand that I may decline to answer any particular question or questions, or to do any of the activities. If I stop participating at all time, all of my data will be purged.

I understand that my responses will be kept strictly confidential, that my name or identity will not be linked to any research materials, and that I will not be identified or identifiable in any report or reports that result from the research.

I give permission for the research team members to have access to my anonymised responses.

I give permission for the research team to re-use my data for future research as specified above.

I agree to take part in the research project as described above.

Participant Name (Please print)	Participant Signature
Researcher Name (Please print)	Researcher Signature

Date

Note: If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, please contact Dr. Angela Lin, Research Ethics Coordinator, Information School, The University of Sheffield (ischool_ethics@sheffield.ac.uk), or to the University Registrar and Secretary.